

October 31, 1960

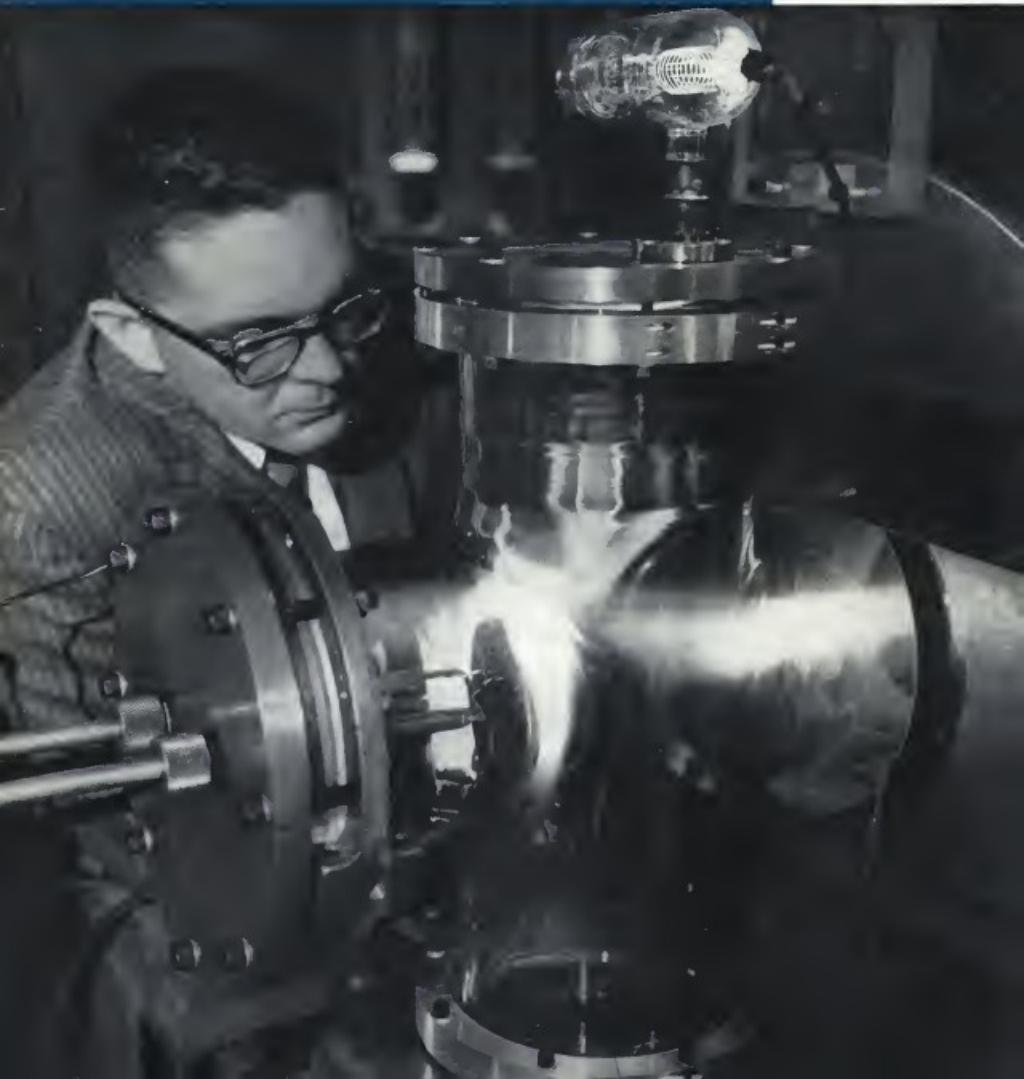
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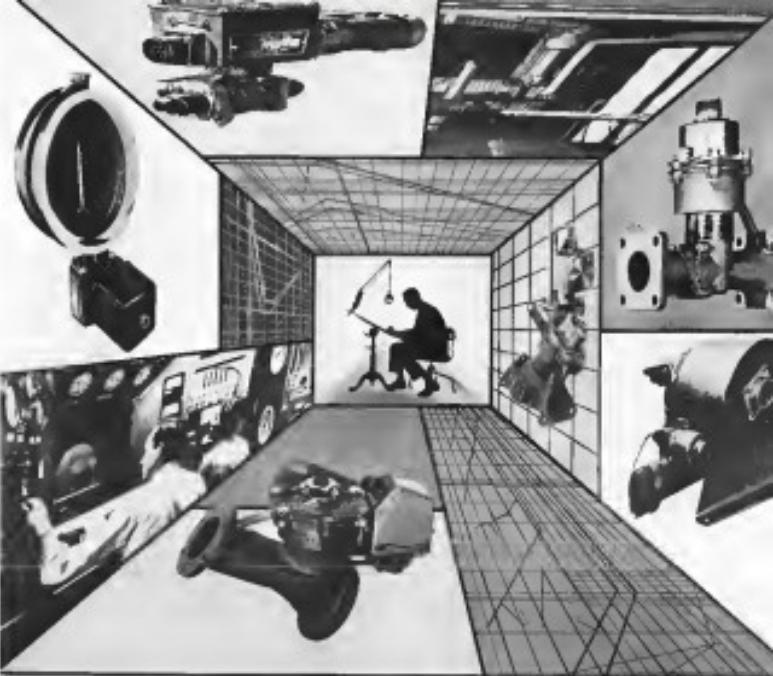
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## AVIATION CALENDAR

(Continued from page 5)

Sept., Adolph Hotel, Dallas, Tex.  
Dec. 16-19 Annual Meeting and Astronaut Exposition, Astoria Hotel, Seattle, Wash., Washington, D. C.

Dec. 18-19 Annual Meeting, National Aviation Trades Assn., Oklahoma City, Oklahoma City, Okla.

Dec. 12-15 Atomic Industry Exhibition, Colorado Mineral Museum, Temple, Texas, featuring Industrial Products Annual Conference, Fairmont Hotel, and the American Nuclear Society's Winter Meeting (Head: Mark Hayashi).

Dec. 13-15-Tenth Annual Forum Joint Computer Committee, New York, N. Y. and American Computer, New York, N. Y. Session Institute of Radio Engineers, Institute of Electrical Engineers.

Dec. 17-20th Wright Brothers Lecture, Mutual Publishing, 100 E. Wisconsin Avenue, Milwaukee, Wis., Wisconsin, D. C.

Dec. 26-31-1970 Meeting, American Association for the Advancement of Science, New York, N. Y.

Dec. 28-December 30, Orange International Vinyl Plastics Meet, Vincent P. J. Jones Auditorium, National Congress on Building and Construction, Ballinger Street Hotel, Philadelphia, Pa.

Jan. 9-11-International Coupling and Fastener Seminar of Automotive Engineers, Eaton Hall, Detroit, Mich.

Jan. 16-18-Second Annual National Meeting, American Astronomical Society, Del Mar, Calif.

Jan. 21-25-1970 Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y., Hotel New Yorker, New York, N. Y.

Feb. 5-8-Second World Military Electronics Convention, Institute of Radio Engineers, Biltmore Hotel, Los Angeles, Calif. 4-Lobular Propellants, Conference, American Rocket Society, Salt Lake City, Utah.

Feb. 15-17-International Solid-State Circuits Conference, Institute of Radio Engineers, University of Pennsylvania, one post, and Statler Hotel, Philadelphia, Pa. 50th Annual Meeting, American Society of Heating, Refrig., and Air Conditioning Engineers, Palmer House Hotel, Chicago, Ill.

Mar. 4-10-Second Symposium on Engines, Dept. of Physics, Massachusetts Institute of Technology, Cambridge, Mass.

Mar. 8-10-Fight Propulsion Meeting, Institute of the Aerospace Sciences, Century City, Calif.

Mar. 11-12-Hot Testing Conference, aerospace Research Society, Los Angeles, Calif.

Mar. 13-15-Tech, Operations and Support Conference, American Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 18-22-International Conference in Solid State Physics, Colgate University, New Haven, Conn., and University of California, Berkeley, Calif. D. C.

Mar. 29-31-International Conference in Solid State Physics, Colgate University, New Haven, Conn., and University of California, Berkeley, Calif. D. C.

May 19-23-International Conference in Solid State Physics, Colgate University, New Haven, Conn., and University of California, Berkeley, Calif. D. C.

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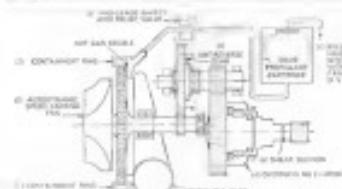
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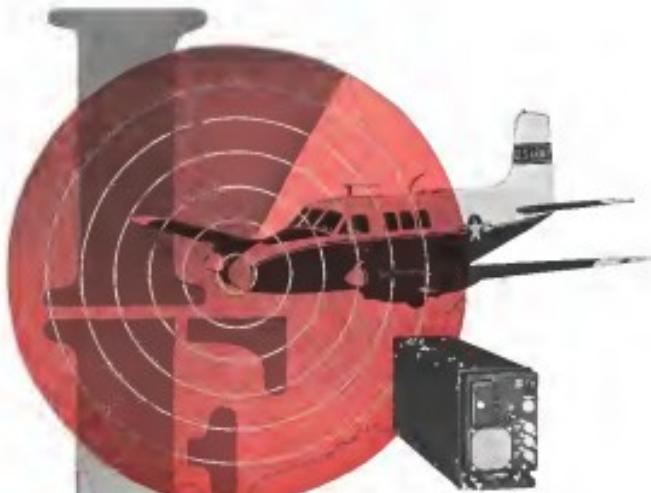
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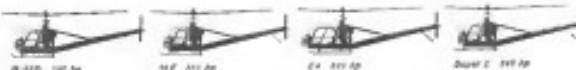
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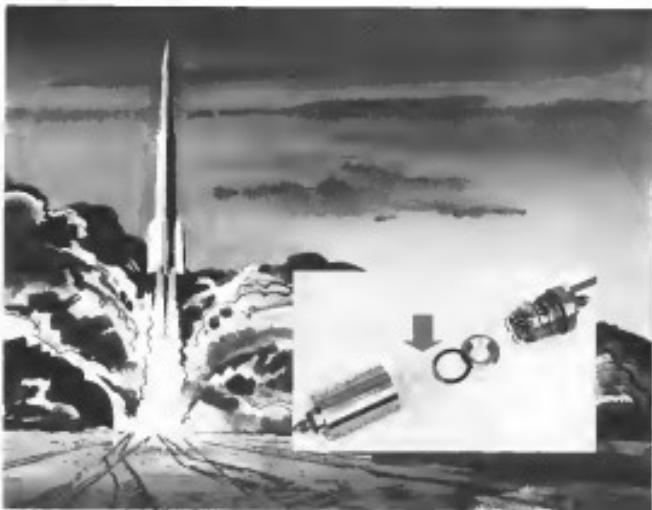
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# TELE-DYNAMICS

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## EDITORIAL

### Some Problems Ahead

The next President of the United States will inherit in a few weeks a heavy agenda of unsolved problems in the national defense area. Most of these are the result of technical instability and chaotic management in the past few years, but some of them will be solely the product of the informed and political ones we are now entering. Both types of problems will have to be tackled by the new chief executive and his cohorts with considerably more vigor, technical literacy and staff than has been demonstrated in their predecessor if this country is to maintain its position as a positive force in the decades ahead. For, given the technical and technical ingenuity now available to all of the major countries in the international arena, we cannot maintain our present position automatically by adding literally one more dimension. Achieving this objective will not only make other but considerably better threats and management of those increased threats.

The failure of the past decade and these bear both Democratic and Republican political labels, were not the failures in one technical skill, industrial capacity or military leadership. Instead, wherever an executive or legislative green light has been fished, the technical progress achieved in specific areas in allotted time spans has been phenomenal.

This has been the failure of our highest level leaders to recognize and understand the nature of the technological evolution that has spread the world in the past decade and the failure to properly appraise and direct our technical, industrial and military resources toward the national goals that this revolution made mandatory for survival in the future.

The problems facing the new President in the defense area fall into two broad categories: those amorphous problems that have become acute through specific situations during the past few years and those long-term problems that require development of new national strategy consistent with the technical revolution and our political goals and require the fundamental reorganization of the management pattern of our military systems and its relationship with the scientific and industrial complex on which it depends for this advanced technology.

In the first category, the most acute problem is undoubtedly that of adequately providing for a communications alert for a significant portion of Strategic Air Command's B-52 fleet. Some steps have been authorized in this direction, but that scale is so small as to be almost meaningless at creating a genuine airborne alert capability for the critical soon as it will be needed most. This is an area where immediate improvement is possible through simple alert and executive action. Unfortunately, not all of the defense problems present such a clear-cut opportunity for swift and decisive action as does the full implementation of SNC's airborne alert capability.

Another immediate division that must be made is the determination to proceed with the development of operational space vehicles in all of the areas where they have already demonstrated their technical feasibility, such as communications, weather, earth viewing and a variety of instrumentation methods. While research and development in these areas has recently been accelerated after a one-month campaign of heavy pressure on the White House by the Congress, military, press and public, there still has been no decision to move into an operational system in any of these vital categories. No matter how swift and successful the research and development phase of these programs is and the progress we have been making—the payoff in operational systems is being needlessly delayed by the lack of an executive decision to move into all of the other areas required to put operational and maintain an operational space system for any of these above named purposes. These agita in an area where a single, clear-cut policy decision offers the prospect of substantial dividends in significant achievements within the next critical year alone.

There are other areas where quick decisions are required to scientific, equal and efficient programs all ready under way. The new President can hardly delay beyond November 3 to begin preparing to exercise his full powers of decision in the new year.

But the most complex and still, serious problem lies in the long-horizon approach to effective management of our defense resources and their continuous tailoring to an evolving pattern of modern strategy, rather than continuing their technology in the pattern of hidebound-looking amateur tradition. This certainly has the scientific staff, the industrial capacity and military vision to lead an international technical race by a continuously significant margin. But as vision can afford to squander these resources indefinitely as a nation that does not translate new technology into effective usage does within a sufficiently short time span.

We are not now getting \$40 billion worth of effective defense for that annual expenditure in the field, and more money is certainly not a panacea for effective selection of the defense problem.

One of the largest obstacles to effective management of the defense effort has been the rather naive confidence of interest lies, requiring top defense officials to frequent themselves of new financial interests in a military contractor, that have effectively hampered real men with horsepower and power ability in the defense area from participating in the low levels of its management. These men have resulted in a steady erosion of stabilized averages, based on short-term brackets at the lowest management levels of the defense effort. It should be obvious to us now that a two year lase of absence from a soap factory is not a satisfactory method of recruiting top-level civilian defense managers.

—Robert Hobs

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## WHO'S WHERE

### In the Front Office

**James M. Blotz**, president, Final Motion Corp. and Cleanout Corp., San Jose, Calif.  
**Howard E. Clegg**, head of development division, Dallas Tex. Alco-Wisconsin Castings, president, Service Division, George W. Joliette III, president, Deltabon Divisions and Jack Meyer, general manager.

**Beverly S. Blomquist**, director, British Aerospace America's VLS Division, is the company's chief executive.

**Samuel J. Johnson**, president, National Aviation Clark Washington, D.C. Mr. Johnson is president of the American Telephone Group.

**G. P. Parker**, president, Irving Air Chariots, Inc., Louisville, Ky., succeeds Leslie L. Irvin, now head chairman. Also E. W. Smith, executive director of the company's Research and Development Division, Cleveland, Ohio.

**Charles H. Wagner**, president, GTE Plytronics Div., New York, succeeds Mr. Irvin, who becomes executive director of the Colorado Manufacturing Institute here.

**James R. Winter**, vice president/program manager, Photo Corp. v Government and Industrial Group, Philadelphia Pa.

**Charles L. Bucklin**, Jr., general manager, president, American Avionics, Inc.

**Robert L. Staudline**, vice president, east lighting, Savoy Corporation of America, Buffalo, N.Y.

**William H. Conpton**, vice president, Antennas, Research and Development Corp., Somerville, N.J.

**Dr. Donald W. Collier**, vice president research, Eastman Kodak Co., Chicago, Ill.

**Frederick F. Broadbent**, Jr., vice president, Air Control Services Corp., Washington, D.C.

**William G. Strain**, vice president, marketing, Menden-Voltek, Inc., Melville, Calif.

**Charles H. Bourne**, president, Control Electronics and Instruments, Inc., Tulsa, Okla., and Wallace G. Thompson, vice president procurement, Control Electronics, Inc., Dallas, Texas, and president of Control Electronics, Inc., Electronics and Instruments.

**John C. Langley**, vice president insulating, The Procter & Gamble Co., Cincinnati, Ill. Also **Keith M. Koenig**, chief project manager, drugs, Thiosulfate General Chemical Co., Cincinnati, and **John C. Langley**, assistant to the president, Thin Coat Systems, Inc., Dublin, Conn.

**Harold R. Logan**, formerly deputy corps member, the Bureau of the Department of Defense, now vice president, engineering and planning for Comsat, Inc., 141 Madison Ave., New York, N.Y. John H. Finch, formerly Director of Budget for Rockwell International, now senior Mr. Logue's director in areas directly comprising his budget.

**Gen. M. D. Adams**, deputy director of strategic development, director of strategic development, Headquarters USAF; also **Gen. T. C. Rebholz**, Jr., comander USAF Strategic Air Command, Malmstrom Air Force Base, Montana; **Gen. James W. Allen**, Training Command, Brooks AFB, Tex. (Continued on page 188)

## INDUSTRY OBSERVER

► North American Aviation is conducting a company-funded study of a solid propellant liquid-blowoff missile for the Mach 1 B-70 bomber. Effective adaptation of the Douglas Skunk ALBM in the B-70 would require extensive redesign, close in development of a second generation weapon.

► Clark receives system projected for Air Force Ballistic Missile Division's advanced B-6 version of the Samos reconnaissance satellite capsule will have to incorporate guidance capability for controlled return to a specified recovery area. Also already at work on an air development, and Northrop's Redophage Division also is preparing a Clark recovery system.

► Boeing will hope its decision on whether to use ground-based command platforms or mobile guidance for its Delta Star's dual-parity payload is resolved by a study in April. Research Corp. is the company's candidate of the two guidance techniques.

► Joint venture arrangements for proposals and for handling work on the mainly and mostly ground support field are under discussion by International Telephone and Telegraph Corp. and Ford Motorcar Corp. This would combine ITT's communications and Ford Motorcar's mechanical and hydraulic capabilities.

► NASA has decided not to include a charginer in the last Little Joe launch of a Mercury capsule. Components currently are being tested at Air Force Missile Development Center, Holloman AFB, for launch over the Middle Range Range or Redstone-based Mercury capsule flight.

► NASA's 5.5-kilometer direct communication satellite is scheduled to be launched Nov. 3 from Cape Canaveral, Fla., with a June 10 vehicle. The 92.5-kilogram payload was developed by Goddard Space Flight Center.

► Barrier-type filters will be installed in USAF Strategic Project Office, such as B-52 and Delta Star, under AFSDC's management of an interceptors effort. Previously, SPDs have had the services of unmodified interceptors that have not had modified personnel-staging devices.

► Intense Soviet drive for overseas aircraft sales was evident the past two weeks at the Tassian International Fair, with the Russians scheduling the Mi-8 helicopter, Yak-42 sport aircraft and the agricultural versions of the Tu-134 linjicar for display.

► NASA Lewis Research Center soon will begin a soil-harvesting research program which will include construction of a soil-harvest module and test vehicles.

► General Motors' new defense systems organization will concentrate at least initially on the submarine detection field. Cooperative rate speed is needed in \$10 million annually to develop a system capability, which was considered too costly for use of its military divisions to pursue out of individual divisional funding.

► Strategic Air Command's 47th Bomb Wing B-52 has been fitted with Mach 2 for a field of more than 75 wins or two segments of a refueled three-hour test flight over the Gulf of Mexico. Longest previous flight above Mach 2 was 18.5 min. during a September World flight.

► Three Kansas B-52 bombers assigned to Warren AFB, Wyo. will remain there after Strategic Air Command completes a shift of their potential use for transportation between ICBM missile sites. The B-52Bs were delivered to Warren directly from the production line.

► Boeing 323 fitted with dummy Douglas Skunk ALBMs under its wings will begin a series of test flights from the company's Wichita Division early in December to check aircraft search-compatibility.

# LIBRASCOPE AIRBORNE COMPUTERS

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## Washington Roundup

### Prestige Debated

U.S. prestige became a major campaign debate last week. Democrats generally took the position that it is at no all-time low while Republicans maintained that it is at an all-time high.

Sense of prestige made him feel that the United States Information Agency became the center of the argument. The White House has refused to make ready of these issues public. It means that anti-communist stations in 10 European countries—denoted secret and in an internal, low-level top paper. Sen. William F. Fulbright, chairman of the Senate Foreign Relations Committee, insists the paper was prepared for the National Security Council and is therefore now high-level.

Fulbright said the European papers, mostly left in August, showed that eight of the 20 countries polled thought Soviet Russia could be superior in the U.S. in military power in 1975. Other polls reportedly reflected the opinion that America's influence is declining.

Democratic presidential candidate Sen. John F. Kennedy accused the Administration of "leaving the world's most powerful nation to pursue Republican candidate Vice President Richard M. Nixon."

Nixon stuck to his position that partition has never been popular, noting this month in recent favorable United Nations votes. He got strong support from Pakistani East Indians who said that when "We have won integrated people and then the U.S. is standing over the states of a partitioned power and their prestige has changed to an all-time low, we are simply listening to dismemberment of the truth."

The White House and the President spoke from his knowledge of all the facts not yet from a position paper prepared for one agency.

### Polaris in Scotland

Britain has agreed to let the U.S. station Polaris fleet ballistic missile submarine at Faslane, Scotland, and the British navy has hinted that it may want to have Polaris early—but it says the U.S. has not yet made such an offer.

Riding successfully is studying a U.S. plan to give NATO Polaris subs. With Britain and the U.S. now the only two nuclear powers, but with France racing rapidly toward an independent nuclear status, the question of arming NATO with its own early-warning system is now critical. Soviet Foreign Minister Andrei Gromyko told the Senate Armed Services Committee that Britain already has nuclear-powered subs armed with missiles; it is time to allow thinking on the Polaris situation.

U.S. and Britain have ratified their 19-year-old agreement on arming of USM at British bases. Robert Kennedy said Britain has some knowledge of U.S. activities and soon, control over USM flights from these bases resolved how the shooting down of a British-based B-57 over the British Sea. Prime Minister Harold Macmillan said the two nations must now decide whether these bases will be "fully known" to the government, but he left unanswered the question of whether Britain now has veto power over specific flights.

Federal Aviation Agency chief E. R. Quanada made a bid last week for the American League baseball franchise in Washington. He will leave FAA in January if he is successful in acquiring the new franchise, created to replace the Senators when they move to Minneapolis.

### Aeroflot Competition

"Aeroflot is not a competitive threat now to U.S. flag carriers, but the Soviet airline will catch U.S. service in four years if it continues to improve at the present rate." This is the suppression Air Transport Area. President Stuart G. Tugman commented from his recent trip to Russia. He feels the pace of Aeroflot improvement would be faster if the airline joined the International Air Transport Association.

Tugman feels Aeroflot has failed to perceive the public preference for transoceanic routes and has made a big mistake in concentrating so heavily on transoceanic

American Rocket Society and American Astronautical Society are about to resume discussion of a possible merger after a hiatus of more than a year.

Capt. Allen F. Fleming will become the new director of Navy's Astronautics Division in December. Currently commanding the center, Capt. Fleming will replace Capt. Richard L. Kibbe, who will become First Fleet chief of staff.

—Washington Staff

# USAF Plans Radical New Space Plane

**Studies costing \$20 million sought in next budget; earth-to-orbit vehicle would need no large booster.**

By Larry Boada

Washington—Air Force is requesting \$20 million in its fiscal 1982 budget for research and development on Space Plane, a radically different aeroshell, winged vehicle that would be both an atmospheric-storing oxygen and in its highest—real orbit space as it is in the atmosphere.

Space Plane would be a 500,000-lb follow-on vehicle to orbital versions of the much smaller Dyna-Soar basic glider. The new vehicle would enter studies designed to lead to flight tests in the 1986-1988 period.

Space Plane would be the first aeroshell space vehicle that could propel itself from orbit into orbit and return to Earth under its own power, reusing any orbital hardware built in Mercury, Apollo and Dyna-Soar.

Most unusual feature of this vehicle is that it would almost double its lift-to-weight ratio to take weight off the upper atmosphere because it would collect oxygen for its engines as it flies.

Dr. Gen. Jerome C. Wilson, deputy chief of staff for development, briefly mentioned USAF's interest in a Dyna-Soar follow-on in a recent speech before the Society of Automotive Engineers' Aerodynamic Meeting and Air Forces' Office of Scientific Research Annual Test Symposium in Los Angeles (AW Mar. 26, p. 32). AVFARS' Wilson has learned that the interest is due to Space Plane's role that it can play in the strategic aerospace mission of which USAF's seeking development funds.

The vehicle might be used for a variety of purposes, including mainly of weapons systems not planned for the rifled gun.

## Several Types of Engines

Possibility of Space Plane would be complicated by choice of solid-inertial engines, growth of the standard rocket boosters, growth of the variable rocket boosters. Propulsion in the range of the atmosphere—25,000 ft to 100,000 ft—would be by use of the variable engines, feeders with hydrogen, air with hydrogen-free oxygen. Atmospheric operation would be assumed in a conventional rocket system, burning liquid hydrogen and liquid oxygen and ketone during atmospheric flight.

Action for the unique orbital steering system is to find ways to roll further from range a lifting-weight vehicle at fixed and constant propellant ratios that are believed to be within the current state of the art and can be available in the here period planned. Space Plane probably would be the last chemically powered space

orbiter combination problem one of the most efficient rocket problems finds, yielding high specific impulse.

Since the increase in gross weight after liftoff would be from 180,000 to 1,000,000 lb, the proportionate amount of liquid hydrogen needed at liftoff would be 62,700 lb. However, an unspecified amount of liquid hydrogen would be required for operation with the oxygen extraction system. Extrapolated to liftoff rate between 10,000 and 25,000 lb/s, the extra amount of hydrogen needed for the regenerating and pressurizing cycle

## Air Liquefying Cycle

Design of the vehicle would incorporate a large nitrogen liquefaction plant would be located forward. Basic principle of the system would be to either the very highly compressed molecules of oxygen and nitrogen, and, through a series of heat exchangers, convert them to a normal gas fuel state. Vehicle would, during the collection cycle, would be about March 15.

The computation as would this year put a heat exchanger whose coolant is liquid hydrogen. Temperature of the exchanger would be -252 °C or colder, which would liquefy the air. From this exchanger the liquefied air would go to a storage tank. From there it would pass through a flow regulator to another heat exchanger whose coolant would take nitrogen with a boiling point of -195 °C, would be separated from oxygen, which has a boiling point of 101 °C. Then the distillation chamber the liquid oxygen would go to a storage classifier where it would be kept until needed for propulsion.

Although the principle outlined above is not new and is possible in accordance with basic rules of physics, major heat transfer problems face the designers because of the difficult task of extracting heat from the gases and liquefying them to liquid.

Space Plane, says, portions of the atmospheric timer would be taken up by heat exchangers and cause impediment before the vehicle will be considered a flying satellite with a large upper weight.

Unless there is a major advance in insulating, the vehicle will be constructed of mylarsides at Dyna-Soar will be USAF Sept. 26, p. 35).

Air Force points emphasize that the concept will be subject to many changes in the study phase and the research and development phases, but the system is based on studies already completed, such as Northrop's Prufit, a vehicle using an oxygen mixture, oxygen similar to the above.

## Crash Kills Nadelman

Alfonso-Vidal Nadelman Nadelman, aerospace commander of Soviet Russia's space command and a Soviet defense minister, was killed on May 24 in a car accident, the government news agency Tass reported.

Gen. Pyotr Nudol Nadelman, chief engineer of the Soviet Ministry of Defense, was also killed in the accident, but he was not identified. Both men were in their 60s.

Gen. Nudol Nadelman has been invited to attend Nadelman's funeral services.



Grumman W2F-1 Makes First Flight

First flight of the prototype Grumman W2F-1, Hawkeye, a Navy turboprop early warning aircraft, was made last week. The aircraft was later demonstrated at a rollout ceremony at the company's Patuxent River facility. The W2F is a two-seater, high-wing aircraft designed for radar detection and control of intruders over Navy task forces. Propulsion for the aircraft uses Allison 501D turboprop engines rated at 1,970 shp, or jet to provide greater speed, endurance and attrite capability than the W2F-1. (AW Mar. 26, p. 31) See preceding article only writing

notes on the front. The Hawkeye service version developed by General Electric's Light Military Electronics Department, is called ATIDS (airborne tactical data system). This radar/infrared/late-link system may offer role intruder detection and control of intruders over Navy task forces. Propulsion for the aircraft uses Allison 501D turboprop engines rated at 1,970 shp, or jet to provide greater speed, endurance and attrite capability than the W2F-1. (AW Mar. 26, p. 31) See preceding article only writing

## U.S. Supersonic Transport Project With Government Funds Expected

Washington—Development of a supersonic transport through development and flight test is anticipated by the Federal Aviation Agency with National Space and Atmospheric Administration assisting in research and acting as technical monitor of the project, now appears likely.

The principle of government support of the development of a supersonic transport has been strongly endorsed in a letter endorsement by the USAF to United Research Inc., which found that the aerospace industry will not embark on a supersonic project with one organization.

Meanwhile, the Federal Aviation of Aviation Corp. has granted a contract to British Aircraft Corp. to begin development on a supersonic transport at such as 51 billion, even with no airfare 70 percent in place. The report stressed that technical and financial risk will be greater by a wide margin than any previous commercial aircraft risk.

The report found that the office estimates "could" and "would" buy an economic supersonic transports if they were available in 1970. This conclusion was based on the fact that substantial traffic growth may be expected during the next decade and that the historical industry trend toward a timely replacement of older equipment with newer and faster aircraft points

to a requirement for a long-haul super音速 transport from commercial air by 1975.

The report concluded that major U.S. carriers will have about 51 billion in seats on hand by 1975 which corresponds to the projected 1980 and 1985 passenger loadings, should provide adequate loads to support the purchase of supersonic aircraft.

The report estimated that, if the plane were available in 1970, U.S. carriers would be in the market for 75 in 1970 and 116 by 1975. Cost of each aircraft in the airline is estimated at \$25 million including spares.

The report estimated, however, that although the commercial market for a supersonic transport was, say, as high as 54 billion in the market, the first four years of 1970 and 1971 would be dominated by the military market to produce a plane that can be operated at initial costs competitive with those of subsonic aircraft. It also said the size will depend on the capabilities of the airlines to integrate supersonic operations into existing facilities and procedures without increasing economic penalties.

The report concluded that there is an "attractive prospect" for a timely commercial program for the development of a supersonic aircraft without government support. It noted that no manufacturer is likely to undertake the financial risks involved without some assurance that market and development costs will be recovered.

# Ion Engine Flight Tests Planned for 1963

By Edward H. Koloski

Washington—Central possible route of choice space program will pass from industry to being encouraged by the National Aeronautics and Space Administration before it decides what sort of fuel or engine will be flown in satellite flights next year starting in early 1963.

First tests of ion-gear engines, Sunbeam-powered ion engines or ion-beam lights are planned as a prelude to a 1965 flight with a SNAP-5 reactor in time, powered by both solar and jet electric engines in a single unit.

Hughes Aircraft Co. currently has a development contract for a laboratory ion engine, and General Electric, Avco and Princeton have contracts for experiments with ion engines. NASA wants to award further study contracts in the field, and it will decide next year which two engines will make the first test flights after studying current work, results of any new basic study contracts and industry proposals.

Contractualized SNAP-5 system will test a 1.1-lb thrust ion engine and a 1.5-kw. thrust at 40 cm/sec. The ion engine would be either a single-chamber model or a cluster of 10 to 15 ion engines.

Primary objective of the first tests,

to be concluded with a 1.5-month period, will be to assess methods of beam acceleration, consider the most feasible technical design problem in ion propulsion. Secondary objective is to establish engine performance parameters by comparing flight and laboratory data. The ion engine must exhaust a neutral beam, since particles in a charged beam would be attracted to the engine structure and form a cloud of the beam resulting in no thrust.

NASA feels that a real test of ion-beam acceleration can only be made in space, even though ion engines have been run for long periods in vacuum tanks. Vacuum chamber walls and residual gases in general are without influence and therefore the test provide a true environment for studying ion-beam dynamics.

NASA's ion-motor development program effort is oriented around three areas in ion propulsion at Lewis Research Center: basic studies in magnetohydrodynamics (MHD) at Langley Research Center; the ion-engine development contract with industry and a number of relatively small contracts to support applied research.

The effort is increasing the effort, mainly through the policy of having proposed to consider, test and analyze industry proposals. However, Schwartz and others are exploring a broad-based list of ion-propulsion development problems.

National Bureau of Standards' propulsive system for use in the next linear electron accelerator, which uses the ion-beam principle, electronics, or ion beams, and electrostatics, also will be magnetohydrodynamic.

The four development contracts now out for three experimental ion engines and one laboratory ion engine NASA plans to request proposals for an MHD engine. NASA also plans to fund several laboratory studies to develop space mission for fast propagation ion and arc engines, specifically where these engines are potentially responsive to chemically heated upper stages. Some ion and arc engines are under individual contracts of existing and proposed Saturn upper stages with the 0.1-kw. thrust ion and 5-kw. thrust arc jet engines.

Ultimate objective for NASA's first generation of solid ion engine—which will be the 30-kw. Ion-5 electrical power to develop 1.1b. thrust over a 10-second operating lifetime with a specific impulse of 4,000 to 5,000 sec.

Hughes Aircraft Co. is constructing an 0.01-kw. experimental ion engine under a \$496,000 contract which will expire in September, 1962. NASA will want this first engine in laboratory tested before deciding whether to have Hughes develop it further as a single-chamber 0.1-lb. thrust system, cluster 10 0.01-kw. engines to

provide this thrust, or go to other firms entirely for flight hardware.

It is expected that at least one flight test will be made of an engine developed at Lewis Research Center.

NASA's ion engine will be the compact method of ionizing certain gases to produce a particle stream. An ionizer is heating a second ion-producing medium, a neutral beam, and is expanded through a nozzle to produce a plasma. Specific impulse in 730 to 1,500 sec.

Several research problems on the ion engine are in progress: start, startup, steady-state operation, plasma storage, loading and burner engine configuration.

Contractors are to solve these problems in one year under coordination in NASA, which is interested in studies of:

• Engine losses from fuel saturation, air flow loss, and from heating and electron damage.

• Cooling techniques, including sonic wave propagation and convection.

• Startup methods, using energy, discharge, bridge wire, reverse electrodes or radioactivity.

• Propellant including oxygen, ammonia, water, and hydrazine.

If fuel can be removed from its normal state, the ion jet engine has the potential of increasing efficiency from 20 to 60%.

Studies also are planned to determine possible use of laser particles for load, once they provide a higher thrust than light ions if both are accelerated at the same velocity. Among potential sources are human waste and planetary dust.

NASA plans an 18-month feasibility study in the MHD propulsive field involving assessment of continuous pulsed and inductive means of accelerating charged particles. Contract also is to select one or two contractors who will explore the entire electrodynamic propulsive potential.

flight test of a 0.5-lb. mass engine and with the 1965 SNAP-5 launch. Flight of a 1.5-kw. engine is under study.

An ion system, formerly called plasma engine, uses a hot gas such as hydrogen or helium as fuel. The gas is heated to a high temperature, passes through an electron gun and is expanded through a nozzle to produce a plasma. Specific impulse in 730 to 1,500 sec.

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weight capability and mainly for retropropulsion and terminal guidance.

• Prospects. This is a study phase development for a Saturn-based vehicle capable of placing a wheeled or tracked mobile probe on the surface of the moon or returning samples of lunar material to the earth. Technical objectives are to develop a system for a Prospector probe which will begin 1961. Full-scale development will begin in 1963. First launch must await NASA's Saturn booster system.

• Surveyor. This project, also in the study phase, is aimed at a orbiter or soft landing as the means. Surveyor will use a Custer long-life vehicle. Its spacecraft will weigh about 1 ton, including guidance and instruments, and it should be able to soft land about 100 lb. of instruments on the moon. Four companies now have NASA contracts for design studies on Surveyor. They are Boeing, North American, McDonnell Aircraft, and Space Technology Laboratories.

• Ranger. In the progress five flights of a PHL (lunar) spacecraft with Atlas-Agena B launch vehicles will be used to roughen 100,000 mph impact instrument package impacting up to 70 lb. on the moon. Propulsion up to the point of impact in the responsibility of the NASA Marshall Space Flight Center.

## Private Industry

Dr. Robert L. Gilruth told 600 industrialists attending the meeting that about 65% of the \$50 million that JPL will spend for NASA's 1963 heat and plasma projects will come from industry. The rest will go to government. Dr. Gilruth said he is to select one or two contractors who will explore the entire electrodynamic propulsive potential.

He said:

"We hope that an active role can be selected in the Venus orbiter for mapping the surface area as far as we can tell, the Venusian cloud cover is opaque to visual systems."

A Mars orbiter will place some emphasis on surface photography. The exact portion of the spectrum to be used is not yet determined, but it will depend on results obtained by ground-based cameras on Mars over recent years.

It is clear that a leading candidate for the Mariner surface must be employed. Such a spacecraft would have visual access to computing to assist in biological exploration programs. It would probably have TV reading microphones working in the ultraviolet and near ultraviolet regions, as well as robots for collecting microorganisms and measuring the changes in the reflect sectors."

## Swiss Favor Mirage III, Saab Draken

Breitling's F-104G and Germany's F111E/F, the two remaining U.S. entries in the 1958 Swiss firm competition for a new fighter aircraft, were tentatively ruled out last week apparently leaving the field open to France's Dassault Mirage III and Sweden's Saab Draken.

Cost was given as the primary reason behind the decision to eliminate the F-104 and F111E/F from consideration, while the French, looking at the bottom of the competition which is more than two years old, expressed some hope that one or both might still be considered.

Some military officials apparently favor the Mirage III as the aircraft that can most successfully compete from the Swiss' short runway, hard to protect other fields and carry out the three-fold mission required upon close-in support, fighter leaders and interceptors.

An air force press release reported in the Marignac leadership characteristics and high altitude performance, and Swiss officials are waiting upon an advisory air warfare liaison committee which Dassault says it can accommodate by reducing the aircraft's loadings.

Mirage III proposals, however, already have been submitted, so the Swiss have no incentive in the past by the Swiss political administration which looks at the thought of any large order from a country belonging to the European Union for economic reasons, as France does, when a similar product can be purchased from the rest of the EEC. Swiss officials, which have a history of being very conservative in their defense, have said little to give the impression of being too eager to buy. Dassault, for a short time, had been hoping to be part of the sale of the aircraft to the Swiss, but in order to increase political confidence, the Swiss may settle the Mirage III and Dassault's proposal.

In placing any new order, the Swiss hope to obtain Swiss rights that would permit Switzerland's own industry to build most of the aircraft involved, including wings.

The Swiss air force at present is composed of 100 Lockheed model interceptors, 100 Hawker Hunters, 150 de Havilland Venoms and 100 de Havilland Vampires.

## NASA's Voyager Venus Probe To Make First Flight in 1965

Pasadena, Calif.—National Aeronautics and Space Administration's Voyager space vehicle will be Shrine G1 and G2 boosters and will enter developmental flights to Venus in 1965. Dr. William J. Pickering and staff members from the Jet Propulsion Laboratory say at Pasadena Laboratories, and in a speech with industry officials here last week.

The Shrine G2 will give Voyager enough additional boost to permit flights outside the plane of the earth's orbit in 1964 and 1965. First launch of a Voyager probe to Mars is scheduled for 1965. It will be a development version, and the vehicle will be a prototype of one to be used for a Mars mission in 1969.

The trajectory will be chosen in the best interest of the spacecraft and will make an earth return trip. The first Voyager will be a Saturn-hoisted extension of the Mariner system with the addition

of a Venus fly-by, in 1962. The second Mariner mission, scheduled as a deep space probe later in 1963 with a north celestial spacecraft and a wider trajectory, to gather additional information data and knowledge of the planet's physical qualities. The third Mariner mission will be a development version and instrument changes will be used for Venus operations in 1964-1965.

It is clear that a leading candidate for the Mariner surface must be employed. Such a spacecraft would have visual access to computing to assist in biological exploration programs. It would probably have TV reading microphones working in the ultraviolet and near ultraviolet regions, as well as robots for collecting microorganisms and measuring the changes in the reflect sectors."

# Nixon Claims U.S. Dominates Space Race

Washington—U.S. has improved many areas of the space race except rocket thrust and will soon move ahead in that area despite failure of the Johnson Administration, Vice President Richard M. Nixon claimed last week.

The Republican presidential candidate predicted no need in use of his son-in-law White Papers on space exploration to demonstrate which strongly emphasized the importance of being first in space exploration, planned the Eisenhower Administration's project in that area, and blamed the policy of the Truman Administration for the slow U.S. start in space technology.

Sen. Kennedy (D-Mass.) attributed his bold political slogan to the Soviet Space, charging that the Eisenhower Administration is allowing the Soviets to outdistance us in the exploration of space. "It is unacceptable of the wise not for an American presidential candidate to obscure the truth about America's negligible relative

strength in space in an attempt to win votes."

"We intend the space competition won't go on behind," he charged. "We just I personally believe the Johnson Administration mislead and ignored the importance of the space race, and now we have to make up the score between 1967 and 1968 when others can out-build us in clear weapons and strategic bombers."

Not until President Franklin Roosevelt in 1945 did the United States begin serious work on the intercontinental ballistic missile. The Republicans insisted said. "Because those responsible for our security believe him did not feel the need for long-range missiles, the U.S. made an effort to match the post World War II missile programs of the Soviets which then in a large measure acted as a point of war from the Germans in the west just preceding the Korean war—the rest of the Soviets were continually applauding that fact.

Nixon charged that the Truman Adminis-

tration "initiated the long range missile development catch-up," and that among his projects "signed off on" was one which might have put the first U.S. satellite in orbit by 1962, Nixon last week asserted.

He added that U.S. must lead in the exploration of space because discovery is one of the tenets of the utility of a people. "We can no more leave this field to George or Iran and still maintain our world leadership than England could have left its new world colony to Spain and still have become the field power of the world during the two centuries that followed in the modern era."

The Eisenhower Administration has "just about closed all unexplored space," Nixon claimed. "We have been hard at work on the related problems—the classified missile gap—like wise mentioned—and we have little reason to fear."

With expenditures of more than a billion a year, utilizing the great resources of the most industrial complex of America as well as that of the federal government," Nixon said. "We have surpassed the Soviet lead in the space competition in all respects but that of rocket thrust where the failure of the last Administration forced the Soviets to a second place lead, and even that lead is soon to be surpassed."

In the fourth television debate between the candidates the previous week, Nixon had gained the rocket problem and had been more positive.

"We are first in the world in space, as I have indicated," he said. "We are first in the world."

The Vice President said that to date the U.S. has launched 29 space satellites and space probes successfully to Russia's eight and the U.S. has, because of the character and value of the accomplishment, one of greater importance than the "superiority of three members."

While the next President is still in office, Nixon said, the first American astronauts "will almost surely complete their space flight," and it is also possible that the next President will receive at the White House the first American astronauts to return from circumlunar flights around the moon.

He said these events are scheduled in the next four years.

"We are proceeding at top priority in the development of many methods of lifting power in excess of the Soviets as they are developing, according to information that I obtain to be reliable. With our own and our half billion pound thrust Saturn vehicle we will take the lead in chemically powered space rockets



**Pratt & Whitney Develops JTFD-12 for Skycrane**

New Pratt & Whitney JTFD-12 gas turbine engine features free turbine drive and will be installed in the Sikorsky S-64 Skycrane helicopter, at a rating of 1,000 shp. Estimated weight of the JTFD-12 turboshaft (including Inlet and Drive) is approximately 1,800 lb. It will be used in the S-64's main rotor system. Photo is courtesy of the P&W turboshaft (Inlet and Drive) program.

• "During the term of office of the next President we will get the first nuclear fueled engine capable of deep space travel," he asserted.

• "In the period of 1968 to 1967 we will launch and operate a manned permanent space station orbiting at some place between 300 and 1,000 mi from the earth, so when our astronauts will go and come and stage flights further into space."

• "We will launch in the period from 1968 to 1969, manned circumnavigations flights."

• "In the early 1970s we will launch manned space ships to land and return from the moon."

"Of course," he warned, "we cannot always lead off in all areas in the race to space, especially for the first time, but we have different strengths with different capabilities." He cited the pledge: "The space capability becomes ours on Jan. 1, 1969. America will be invited to assist in the long strike into outer space."

The Republican candidate said it should be understood that this effort will be expensive, but he believed that every dollar that could be spent on structures and equipment should be invested in the effort to qualify the exploration into the world of outer planetary space.

## Convair, GE, Martin Win Apollo Contracts

Washington—Contracts to study feasibility of the multi-mission Project Apollo spacecraft will be awarded to Convair Division of General Dynamics Corp., General Electric Marine and Space Vehicle Department and Martin Co. Baltimore Division.

National Aeronautics and Space Administration is negotiating additional \$748,000,000 for contracts with the three companies and they will be awarded Nov. 15. The research studies are designed to provide a variety of options for the design of the multi-mission for early orbiter and circumlunar missions, cost and facilities required to implement the program, identification of existing technical anomalies which could block the program (AWW Aug. 28, p. 261, and a cost analysis).

Convair, GE and Martin were selected to conduct the studies from among 14 firms bideting bids.

Although NASA did not specify when initiation of studies in the feasibility study, two successful bidders have chosen several partners, and another of three will add a number of subcontractors to the studies developed.

Apollo Astronautics Div., will join GE for work in the areas of high temperature structures, propulsive energy management and reaction controls.

## Cessna Unveils 1961 Line

Wichita, Kan.—Major changes are evident in Cessna Aircraft Co.'s 1961 line of business aircraft, being introduced this week at the company's annual distributor and dealers meeting, which runs through Nov. 2.

See new models, including the two-place Skymaster derivative, see living room in the first floor, including a sliding glass door at the side connecting between the Canadian and Wichita facilities.

Named the Skymaster, the new Model 315 multiplace airplane is powered by a Continental 300-075F 260-hp reciprocating engine similar to that in the Model 310 and 310B airplanes. The new airplane, Convair 315, was designed in response to expanded revenue and performance requirements particularly as regards to heavier payloads than are possible in the 1950s.

Of configuration similar to the Model 310, including taildragger type, the Skymaster is designed to carry an air load 37% less of landing and takeoff (101 lb. standard) or speeds up to 152 mph. Gross weight is 3,120 lb., and empty weight is 2,250 lb. At 161 mph cruise, the Skymaster will have a range of 1,000 miles, a distance to a station of 1,100 mi., and a range to a point of 510 miles for the standard maximum payload factor.

Based first on the single-engine 310, plus additional other versions such as the 310C Convair 310F, the passenger load limit, nose cap of the airplane is increased so that under certain seating the seating edge seats of the wing loads have a much new load and the third added without risk of the fuselage provides increased stability for rear passengers. The 310F, powered by 160-hp Continental 300-075F engine, is equipped with new Scotch retrograde suspension for easier and faster entry. Two cockpit windows, the starboard window and optional deletion switch are incorporated in the 310F. Stabiles enables a more movement inhibiting, perhaps more full extension of the stabilizer armature and end-on-elevator wings. The 310F will sell for \$52,500 in the standard version of the fastest.

Improved Model 172, featuring a wide fuselage, will be available in two versions, the standard 172 and the high completely equipped companion Skyhawk. Landing gear on these airplanes have been shortened there to provide easier ground handling. Powered by a 160-hp Continental O-200-10 160-hp, the new 172 will sell for \$34,950 in the standard version, \$3,400 for the nose and \$2,000 for the tail section.

Convair also is right now finalizing its complete model line for 1961. Being shown are the Model 215, Model 310F, 172 and Skyhawk, the 190 and the Skycrane helicopter (AWW Oct. 15, p. 11). Details of the other airplanes for 1961, including the Model 175 and Skylane, Model 190 and 310 will be released at simultaneous nationwide dealer showings scheduled for Dec. 2.

Contract team members selected by the Air Force Air Materiel and Test and Evaluation Division for Michael Electronics Research Center:

Under terms of the GE contract, Underwood will manufacture 172 aircraft systems with an option which allows under certain 36 days for either another 40 aircraft or 18 months or a stage programming clause at the end of 18 months. If 100 aircraft are delivered individual lots will fill the opportunity to rely on a local option alternate arrangement under which they would receive a 5% surcharge in 18 months instead of 4% but would get a more liberal receipt and delivery plan.

Worthington, agreement, similar to the one with GE, provides incentive of 4 to 16 cents per hour based on a monthly rate in 18 months, with more incentive if the contractor can satisfy a certain plan. Both companies dropped fixed cost/leasing evaluation clauses, a bone of contention with the AFM.

# AT&T Plans Satellite Launch in One Year

By Philip J. Kranz

Washington—American Telephone & Telegraph Co. has sharply accelerated its commercial communications satellite program and now expects to have an experimental satellite in orbit within a year. The satellite will provide one-way television via a direct link between the U.S. and Western Europe.

The company has asked the Federal Communications Commission to allocate two 100 mc bands for its one-way satellite communications links at 6,475-6,625 mc and 6,775-6,925 mc. The FCC is expected to rule on the company's petition that it receives priority frequency allocations above 5950 mc for private television systems. AT&T, which earlier had opposed the 880 mc television allocation on commercial grounds, warned FCC in July that failure to impose the cap could result in serious interference problems for communications satellites (AVW July 15, p. 37).

## AT&T Announcement

The AT&T announcement of its new satellite plans also followed a recent statement by National Aeronautics and Space Administration chief Keith Glavin that the agency would launch com-

mmercial satellites at least (AVW Oct. 13, p. 20).

Company's "within one year" timetable for placing its first experimental communications satellite in orbit at 2,200 mi. altitude represents a sharp acceleration of the AT&T program.

Three months ago, when AT&T filed a 227-page petition with FCC arguing it deserves the above-880 mc band because of its communications needs for space travel, the company went into considerable detail on a variety of its satellite requirements, except for one feature: feasible one-way TV. It is unique in its diversity. When open, says AT&T, satellite advocates feel that the first experimental satellite was expected to be used for broadcasting "in a simple voice."

Observe as our second possible explanation for the later voice filing of the AT&T program. One is company concern lest previous filings for the government to move into the commercial communications satellite field to accelerate the program and beat the USSR in the race (AVW Aug. 5, p. 11). Another is the filing plan. AT&T Vice President Ernest T. Kilkenny, in charge of the company's Long-Distance Department, stated:

The British group is headed by Maj. Gen. D. M. Thawley, (ret.), and includes representatives of the Post Office, Science and Aviation Ministers and the Admiralty. The tour will end Nov. 30.

We believe that the measured application of satellite communications is a

## British Discuss Satellites

Washington—British communications officials invited a team of U.S. industry and government officials last week to explore possibilities of cooperating in future communications satellite programs.

Preliminary discussions are being held with Federal Communications Commission, National Aeronautics and Space Administration, International and Commercial Space Flight Center, Defense Department, Bell Telephone Laboratories, International Telephone & Telegraph Corp., Radio Corporation of America, American Telephone & Telegraph Corp., Johns Hopkins University, Naval Signal Center at Ft. Monmouth, N. J., Air Force Ballistic Missile Division, Space Technology Laboratories, Massachusetts Institute of Technology, and the Air Force Command and Control Development Division.

The British group is headed by Maj. Gen. D. M. Thawley, (ret.) and includes representatives of the Post Office, Science and Aviation Ministers and the Admiralty. The tour will end Nov. 30.

a job for private engineers. This new project is still another indication of our confidence to take on that job and pay our way." <sup>12</sup>

Another motivating factor could be the growing number of private companies which have launched commercial communications satellite study and/or development programs. Last fall included Bendix, General Electric, Hughes Aircraft, International Telephone & Telegraph Co., Radio Corp. of America and Space Electronics Corp.

## AT&T Specifications

The experimental satellite, which AT&T will construct, is expected to measure about 50 in. in diameter and weigh about 175 lb. It will be powered by solar cells. Satellite payload is reported to be completely transnational except for licensing laws imposed in the two countries. Satellite transponder output will be one or two watts. Two slotted antennas around the satellite unit will be used for transmitter and receiver.

The initial route, the U.S. ground station will be located at the Bell Telephone Laboratories facility in Holmdel, N. J. Other terminal for the transatlantic link will be located in Britain, or possibly on the continent. A Western Europe Station at Holmdel will use a 1.1-wavelength transmitter.

In addition to the two 100 mc bands

## ARPA Studies Satellite-Borne Anti-ICBM Defense System

Washington—Advanced Research Projects Agency is considering the implementation of an advanced satellite-based anti-ICBM defense system. In its estimate, said if the decision is made to go ahead with the plan, requests for proposals can be issued by the Air Force's Ballistic Missile Division for earth-wide coverage soon, probably before the end of the year.

During the coming year, Lockheed and Thompson Ramo Wooldridge have conducted feasibility studies for such anti-ICBM systems over the past year or more and are expected to be among the principal contenders.

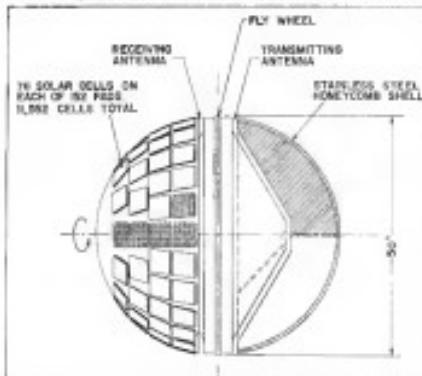
In anticipation of the need for such a system, ARPA has been leading analytical studies of similar but competing anti-ICBM systems. These include the Baseline Range System (BRS), a program which could employ a multitude of small satellites placed in random orbits for the purpose of detecting incoming anti-ICBM ballistic missiles.

Since Baseline is situated in a follow-on effort to Thompson Ramo Wooldridge's Advanced Research Project, ARPA's own efforts after the return from the military's studies switched from BRS's Range Warning Division earlier this year. The ARPA approach would employ a greater quantity of satellites than would the Baseline System, although the total number of anti-ICBM missiles employed in the satellites of either system would be roughly the same. For example, each BRS satellite might carry one counter weapon, while a BRS satellite might have six, but the BRS would be approximately six times as many satellites.

An important political question concerns the general public's reaction to the proposed anti-ICBM defense. Public opinion abroad has been mixed to placing in orbit military systems in space despite existence of the defense armistice. It may be difficult to convince others that BRS, Spad or any other named anti-ICBM satellite defense system would include a built-in capability for being rendered harmless on receipt of a suitable signal.

A proposal for another Baseline system which could extend the time interval for the kill while the missile is still in its launch phase is being made for submission to AFSC in Florida. Under this proposal, the Baseline satellite would also have the ability to assess the need for anti-ICBM system USAF has assigned the Strategic Space Combat Weapons System (SSC) to the system that would grow out of these studies, they add.

Self-destruct programs, thus one in



**ACTIVE** speaker communications satellite, which American Telephone & Telegraph Co. hopes to place a 2,200 mi. orbit within a year, will provide two-way television and private voice/data channels. Subsequent operational models will provide both TV and voice/data channels. Satellite will weigh about 175 lb., be powered by solar cells.



## N. Y. Port Authority Takes Delta To Court Over Idlewild Jet Noise

By Gross Garrison

New York.—Action by the Port of New York Authority last week in seeking a state court injunction to restrain Delta Air Lines from violating the agency's jet noise regulations at Idlewild is expected to bring in a broad legal challenge against the authority's power to enforce aerospace requirements at its airports.

The Port Authority filed a complaint in the Supreme Court of the State of New York in Queens County, asking an injunction to restrain Delta from violating the agency's rules and regulations. The action should provide an important test case of the agency operator's jurisdiction in areas that affect airport flight operations.

Under its original jet noise rules, the Port Authority specified certain aircraft procedures the airlines were to follow after takeoff, including power settings and turns. This rules limit was assumed to have been sufficient to allow for certain categories of aircraft to fly over the airport. The rules also included a preferred maneuver system.

Federal Aviation Agency on Oct. 15 submitted its own set of noise rules at Idlewild, differing in two important respects from the Port Authority's: the FAA rules permit eight flights/ons on some runways; the Port Authority rules prohibit, and the FAA rules do not limit maximum noise levels over adjacent communities, in the Port Authority rules do. The Port Authority said that its rules would serve to offset signals of those discrepancies.

Delta, the Port Authority charged, has repeatedly ignored and violated

part of it has, Delta said, the airline wants to go ahead and make the move. It expects support from the rest of the industry.

According to some reports, Delta planes have been making landings in the 500-foot fall-off zone from the flat downtown pastures. The airline said that the single has been true to some extent before the hearing, but not after it.

Delta also operates the Douglas DC-8 from Idlewild, and the Port Authority's aviation tally includes operations with this aircraft. The agency and Delta's September record included 51 violations out of 140 jet flights, or 36.4%. Of 2,007 flights in all surface at Idlewild during the same month according to the agency, some 70% or 1,400 were in violation of the rules.

This overall September percentage compares with 50 violations out of 2,279 jet flights out from Newark, or 21.7%, the Port Authority said, indicating a steady decline in some categories.

The Port Authority and Delta officials met in New York Oct. 14 and the Port Authority and Delta also informed that action would be taken vis-a-vis the violation count. Additional eight violations followed on Oct. 16 and 18, the agency charged.

Delta told *AeroNews Weekly* that H. G. Farwarrin, chief 900 pilot had come up from Atlanta for the meeting and that since then it believed the situation had improved and that pilots were following "the spirit and the letter" of the rules. The airline said it thought the matter had been settled "amicably."

It came as a surprise, according to DeLoach, when the action was taken and that apparently the Port Authority had been preparing its complaint for some time.

Since the matter has advanced to the

## Eastern Seeks New No-Reservation Service

New York—Expansion of Eastern Air Lines' reservation, low-fare service to Miami was proposed last week at the carrier's plan to file a suit with Civil Aeronautics Board to add Charlotte-Mecklenburg and Ft. Lauderdale service to the existing Philadelphia-Miami service (AW Sept. 17, p. 47).

Eastern, on Oct. 14, also will seek the service from Pittsburgh, Detroit, or Memphis, with reservations, the Air Transport Association, in a still-undeveloped service.

One-way fare from St. Louis to Miami under the proposal will be \$40. One-way to Miami the proposed fare is \$40. Eastern and this is a 25% reduction from current cash fares on the routes. The Pittsburgh-Miami fare is \$40.

Airline telephone reservations are not required under the plan. Seat selection is to start at the time of ticket purchase or 24 hours before departure time. The proposal calls for reduction of the entire ticket price unless it has been tampered with before that time. But CAB is still studying the merit of the proposal. The ticketless provision has been in effect in the Pittsburgh-Miami service.

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## Baker Traces History of Capital Troubles

By L. E. Doty

Washington—Capital Airlines, about to lose its corporate identity through acquisition by United Air Lines, stands out as an economic case history in the evolution of the domestic airline industry.

The carrier—the nation's fifth largest until it became bogged down with financial difficulties—has, for just practical purposes, marked the end of its 19 year career as an individual part of the U.S. transportation system. Only CAB approval of the merger, which it expected, is now required to open the way for absorption by United and thus eliminate Capital as a corporate entity.

Capital's history, its growth and development will attract the study and critical examination of management techniques for the basic reasons behind the company's decline and fall. Capital's fortunes in the merger case have brought much of this background out into the open, but most testimony has centered around the need for the merger rather than the reason the need developed in the first place.

In an effort to turn the cities and events which led to the Vietnam invasion ship set and ultimately to the United merger ship, *AeroNews Weekly* has discussed Capital's problems with President David B. Baker.

For more than three years, Baker, as president, has been indirectly associated with Capital's financial dilemma, which started in 1967. In late 1967, a year after he took office, he told *AeroNews Weekly* that Capital "is in a number of owned regions [the] intermediate and active routes to seek an appropriate merger." This advice followed shortly after the Vietnam War began in 1965.

In a detailed analysis of Capital's situation, Baker tried to determine the exact nature of Capital's fiscal plight. These are the major factors which Baker found existing in 1967 and which he believes blocked the carrier from returning financial strength and preventing it from being an effective airline competitor:

• The airline failed to assimilate most of unprofitable routes and took longer bid routes or consider a merger. He said that these three basic approaches were used to management in 1957. He charged that management's relationship with the CAB staff, "as my opinion," were unsatisfactory, noting that compensation and travel expenses were being handled as a part time job. He added that in 1957, Capital had an unusual plan for improving its position and that it was not organized to attain an implement a plan even if it had one.

• Capital's compensation program failed to include plans for the retirement of out dated aircraft early to operate, Baker said. He had no direct evidence of the

and organization." He charged that there was a "serious lack" between the operations and sales departments which affected operations and individual relationships as a cause. Baker said one person, the chairman of the board, was not involved enough in making plans as did any individual in management. He said there was no formal top-level group to consider and recommend policy and no specified organizational responsibilities. Important functions of passenger policy was split, he said, and there were no wage standards, no personnel evaluation system, no annual management audit, and "the company did not even have a supervisor program."

• Baker said the airline had a higher percentage of unexpired leases than any other airline. Capital paid no dividends other than one other airline, but the airline was unprofitable, which the carrier, he said, was engaged in labor negotiations with the mechanics union, "which was completely undependable."

• Baker said Capital had been living on a day-to-day basis financially while other carriers were developing long-range financial programs. He said that no efforts had been made for public financing, particularly when negotiating the Vietnam, and that the carrier's financial status was "unsatisfactory, marginal and constantly revised." He said the airline had 23.5% of all the debt outstanding among regional airports in 1957, and in that year, its debt was \$5.5 million. The present is the industry's "worst financial condition," he said. He noted that capital to 1970, of all in transit aircraft, he assigned to all regional carriers.

• Capital's earnings position was unfavorable when its depreciation rate fell below industry levels, he said. However, with the purchase of the Vikings, Capital's depreciation increased to 19.5% of revenue, compared with an industry level of 8.1%. Baker then said that, with annual depreciation of \$10 million, interest payments and capital expenditures requirements, Capital, as of last year, had to give up \$16.5 million in 1970 and about \$11.3 million in 1971 in excess of the depreciation rate, and that after payment for capital expenditures and interest plus whatever permanent increase in working capital requirements accompanied the growth in operating expenses and revenue.

Baker has overlooked that many of Capital's current difficulties stem from the failure of Capital's management in the late 1950s and early 1960s. To visualize the future development of air transportation from DC-3 operations

deploring the Pennsylvania Railroad in the face to the entirely efficient operation experienced in 1950 and 1951.

Baker began exploration of merger possibilities in December, 1951, when, at a Board of Directors meeting, a special committee was established for the purpose of studying merger potential. The committee consisted of five board members.

During the ensuing period several memorandum studies of merger possibilities with eight airlines or combinations of airlines were made, and merger approaches with other carriers began. In all, informal discussions of possible mergers were held with TWA, Eastern, Pan Am, Delta, Northwest, and Northeast. United was the last carrier to be contacted.

As part of his effort to contact the difficulties in Capital's operations, Baker developed a financial program designed to provide long-term financing for new turbine engines and to stretch out the Vickers debt from 1947 to 1957 at an average interest rate of 41% instead of 41.

A working tax audit with Vickers in England was April 25, 1952, to consider the feasibility of launching the new financing program at the same time the merger studies were being conducted. Since it was apparent that the proposed program by within the terms of possibility, Capital put first priority on the engine/turbine project, and carefully the managers were placed second in order of importance.

The overall plan called for the retirement of nine DC-3s and three L-1049s in 1956, with full retirement of these remaining L-1049s by July 1958. A full fleet of 11 DC-3s, which were leased in 1951 from Pan Am, was to be sold at cost per aircraft, or shared by purchase of old aircraft. Balance of DC-3s to be retired when small aircraft were released from Capital's status creation by the CAB's Purchase of Control (POC) ruling; 41 transports and Lockheed transports aircraft was included in the program.

To increase capacity seats in the Vickers were increased from 44 to 46 by eliminating one heating, and further plans were made to increase the number to 50—the equivalent of adding eight Vickers to the fleet from a seat-mile capacity standpoint, according to Baker.

Meanwhile, Baker established a department to coordinate route markets, this was made to route committees to San Antonio, Houston, Dallas, and Tulsa, and a fine plan was developed to obtain authority to operate from 13 small stations. The carrier was granted a Great Lakes Florida route in 1951 and a Minneapolis-Chicago route in 1952.

Six new management members were brought into the company by Baker in

a reorganization move. An organization manual was published and an executive management council of the top six officers was created to consider major policies and decisions. All matters affecting expenses were centralized by a budget committee, council with all officers members. A corporate affairs department was created and planning committees were established.

A management audit unit was formed to evaluate company performance and the development of its organization and plan for all maintenance functions and facilities was provided for by retaining Wilcox and Clark Consultants.

Baker made no real moves to increase revenue, including an increase in Vickers utilization from 81.1% in 1951 to 90.1% in 1959. According to Baker, Capital's load factor in 1959 was second highest of all regional carriers compared with fifth place in 1957, and its load factor of 35.4% in 1956 compared with a regional average of 31.6%. He added that, despite that performance, Capital's revenues in 1959 totalled \$103.5 million, up 19.7% to just \$83.5 million in 1957. He gave the reason for the ultimate flight right.

"Capital's inability to add slot miles as carefully planned increments as our competitors had was the basic reason why over all revenues did not go up as rapidly as other carriers even though acceptable entries such as local factors showed outstanding results."

Baker's move to Bell's relatively young captive fleet included in 1952 personnel emphasis in July, 1953. In 1950, the airline was able to net over \$100 million but it worsened the merged plan but it worsened the CAB's plan if the merger is not approved, the British company will proceed with its four-month effort.

## Supplemental Airlines Win Court Approval

**Washington—Supplemental**, which won a major legal victory last week when the Supreme Court overruled an appeals court decision which challenged the authority of the Civil Aeronautics Board to curtail routes.

During the U.S. Court of Appeals to create a judgment board against a CAB decision in the Long Ranger Case, the Supreme Court Justice ordered the appeals court to issue a stay pending review of the court's decision by the CACB to curtail routes.

In another action, Delta Air Lines was denied review of a court of appeals decision which upheld a CAB order directing the airline to pay back more than \$1,765,000 in subsidy funds to Pan American and Southern Airways, which was absorbed by Delta in 1955.

Various attempts were made during

the litigation move. An organization manual was published and an executive management council of the top six officers was created to consider major policies and decisions. All matters affecting expenses were centralized by a budget committee, council with all officers members. A corporate affairs department was created and planning committees were established.

A management audit unit was formed to evaluate company performance and the development of its organization and plan for all maintenance functions and facilities was provided for by retaining Wilcox and Clark Consultants.

Baker suggested that continued operation of the Vickers fleet, combined with a settlement of equipment rates at the time a merger would be consummated, was the best way of settling "authorities" interest. At the same time, he proposed that partial payment toward principal could be made by the airline in kind rather than by a regular airline member of Vickers. Reduced capacity, he said, could be replaced by short-term leasing of aircraft pending final resolution. He also suggested a gradual cut in slots which would help the carrier to manage the discontinuation of a divisional role of the new fleet, provide for orderly replacement of equipment and avoid "the spectacle of an airline without aircraft to serve its authorized route."

Vickers agreed to several postponements of its disbursement action while discussions were under way with Baker, and the merger plan concluded late in July (AW, Aug. 8, p. 40). Vicks has imposed the merger plan but it worsened the CAB's plan if the merger is not approved, the British company will proceed with its four-month effort.

## State Regulation Threat Worries Airlines

By Robert H. Cook

**Washington—Carrier legal battles between Bonanza and Frontier Airlines and the states of Nevada and Nebraska are being followed with concern by many airlines, which fear that judicial support of state laws' regulations which would give state broad powers over airline operations, through existing state railroad or utility commissions. Such legislation was introduced 15 years ago in 22 state legislatures, but it was enacted only in Alabama, Arkansas and Vermont on a limited form.**

Reviewing around the issue of whether state rights versus federal regulation, the two cases are regarded as a direct challenge to the Civil Aeronautics Board's power in permitting local service and making airfares to and from state airports available to state railroads or utility service companies.

While the case in Nevada and Nebraska are concerned only with service, route, and legal guidance of state authorities applied to CAB authority, as in other states no issues of airline certification and fares.

### CAB Hasn't Interfered

So far, the CAB has not intervened in these court cases, but the Board could later be forced to do so if the state courts uphold Nevada and Nebraska, which curtailed the two local service carriers to continue service after they were permitted to disband if the CAB did not.

Conflict between state and federal offices, Bonanza and Frontier are faced with heavy fines and penalties from the states if they drop the issues and possibly federal vehicle fees if they settle it.

Putting out that CAB has been threatening to make its range unlawful by such measures as the "use it or lose it" statute which the two carriers were permitted to drop the disputed service, CAB says it may be forced to finally establish its authority on these and other similar points through a series of lengthy court proceedings or by seeking an amendment to the Federal Aviation Act.

While those problems are being faced by the two states now, there would be considerable ramifications, since 37 states have constitutional or statutory control over some aspects of or control within their borders. Although a majority of these states have not attempted to apply those powers, 21 have some form of control over airline rates, 25 can require local subsidies and, Franklin, in addition, has granted a certificate for interstate operation and 18 have regulations requiring the filing and approval of all tariff before

their implementation within the state. Although the probability was seen remote at this time, there is also a danger that one state's legal action might lead to a series of actions by many states, which fear that judicial support of state laws' regulations which would give state broad powers over airline operations, through existing state railroad or utility commissions.

The Nevada commission ordered the service suspended in October, 1959. The airline obtained a temporary injunction against this rule but lost its appeal for a declaratory judgment and permanent injunction when a majority decision of a three-judge court ruled that the case did not come under federal jurisdiction. In a dissenting opinion, the third judge held that the case should have been heard on grounds that curtailing the airline would be costly to the public and that most of the carriers in question of the legal validity of demands made by the State of Nevada.

The case was filed in Nevada's 3rd Judicial District Court, and was heard in September on a difficult set of facts since the airline's original action was based upon a CAB airway permit order. A subsequent Board order, issued last July, defined the two routes from the airline's routes. No decision had been reached by the court late last week.

### Frontier Case

While Bonanza's case has involved only two points within the state, Frontier Airlines faces a similar problem with two state route suggestions at Nebraska. On the basis of its Judgment 13, naming the cities of Cheyenne, Lincoln, and Omaha, Nebraska, and Colorado, which cities had an agreed route filing rules on the calendar and is now considering legislation to expand its powers to release route certification of interests which bring any intra-state routes.

### Immediate Threat

In the more immediate future, many airline carriers can use the use of state powers as a possible threat to CAB's effort to add routes or dropping poor revenue producing routes and in the Board's exercise of a claim that can give state authorities relatively greater powers on specific routes with a filing rule based on schedule frequencies.

In the case of Bonanza, the airline was certified by the State of Nevada as an interstate airline in 1946 under a Reno-Las Vegas route which later included the cities of Hawthorne and Tonopah. Several years later, the airline was granted a certificate for interstate operation by the CAB and last year initiated the Public Service Commission at Nevada that it intended to drop

its route to Hawthorne and Tonopah on the basis of CAB approval, which the airline maintained had precedence over state authority.

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made which it had ordered deleted. Nebraska told the St. Louis panel that if from the Board could continue down a path which caused regard in air traffic controller. They want to CAB's concern over the mounting safety cuts and by a recent Board order giving Southern Airports several Tennessee ports friendly to the route of Southeast Airlines. In the end, the Board argued that if the state had been willing to waive Southeast's safety costs, the ports might have been left on the infinite way back.

Although the Bureau and Memphis can see the logic of industry structure, safety problems with state regulatory bodies in the past have caused heavy financial losses to several interstate carriers in the field of fault flags.

Confusion, which requires trill of

signs for all interstate operations and approved by the Federal Aviation Commission, but they may be phased out, it said, until such time as a case is put before the Los Angeles San Francisco committee of the CAB.

Although the newest general passenger fare increase of 2.5% plus 5¢ per mile effect in July and was filed with the California PUC under funds of Western, United and Texas World Airlines, the carriers have not yet been permitted to charge the higher fares on the interstate route pending a decision from the commission, which held hearings on the increase last month. West Air estimates its first revenue on the route at nearly \$170,000 a day, or while TWA says that figure at about \$40,000 and United, with the lowest schedules, estimates the ton in date at \$90,000.

This same problem can work in reverse.

## CAB Reports to Congress on Electra Crash

By Fred Eastman

### Washington—No evidence of a structural failure that would have meant the crash of an Eastern Air Lines Lockheed Electra at Boston Harbor Oct. 4 has been found, the Civil Aeronautics Board said in a progress report to Congress.

CAB did repeat, however, that there is evidence of a "foreign object strike" in the No. 1 engine air scoop prior to impact, and that engine appeared to have been shot down and its propeller feathers broken before impact. There also was evidence of striking foreign in the air scoop and oil cooler on engines No. 2 and 4, and damage to the engine No. 3 and 4, but no evidence of mechanical difficulty or malfunction of these four engines. No damage was found in engines No. 2, 3 and 4.

The amateur investigation program report was sent to Sen. A. S. Mike Monroney (D-Okl.), chairman of the Senate Commerce Aviation Subcommittee, and Rep. John R. Williams (D-Minn.), chairman of the House Commerce Subcommittee on Transportation and Astronautics, by CAB Chairman William Goldfarb. The House group plan to investigate the whole Electra situation after the election.

The report appears to support Federal Aviation Agency Administrator E. R. Gucken's statement that there was no evidence of a structural failure involved in the accident (AVW Oct. 16, p. 10), although the FAA had ruled that the aircraft was not fit for service. But it is not conclusive regarding his conclusion that the accident might have been caused by flying into a flock of robins.

Chairman Goldfarb warned that the

issue, as indicated by the experience of Western, will be appealed to the CAB again, perhaps years from now. The Los Angeles San Francisco route without the approval of the PUC. Final approval of the fare by the commission more than two months later, also caused an order that Western release \$17.75 for each ticket sold for interstate travel over the route in the period preceding PUC approval.

While the over-all problem of state regulation is not entirely widespread, it can present a variety of minor irritations. American Airlines, for example, which looks as unstable outside from the State of Illinois, is awaiting action by the Illinois Commerce Commission on a position to abandon service at Peoria and Springfield. The commission heard American's request but made, but has not yet announced a decision.

were at blade angles of 15 to 30 deg. of pitch at impact, indicating that all three engines were developing maximum power.

The CAB's final inspection of the No. 1 engine indicated that it had been subjected to extreme overtemperature conditions resulting in severe deformation and damage to that engine's combustion chamber area prior to shutdown. The feathers or parts of feathers found in the air scoop and oil cooler of engines 1 and 4 had been identified as striking feathers.

A number of samples of feathers earlier have been recovered from the wreckage scene, the blades of oil cooler, fuel nozzle, diffuser section, burner core and turbine section of the No. 3 engine," the report said. "The material recovered consisted of steel, carbon, marine life, feather, bone, and skin.

"Although all of this material has not been completely identified," the report said, "none of the feather fragments have been identified as striking remains. The issue and bones are being further investigated by the laboratory of the FBI and Southeastern Institute."

The report said similar findings cannot be made at present for the Nos. 2 and 4 engines and is being analyzed, but that no foreign matter was found in the No. 3 engine. However, feathers were found in the generator of Nos. 1, 2 and 4 engines. The No. 3 engine generator had not yet been disassembled.

The generators were enginedriven and were driven by an input from the engine oil cooler usage and disassembled at the generators by fire and moderate feasible ducts.

Hydraulic boost packages and other aircraft reserve components have been shipped to Miami. The flight and engine control systems, which were found to attempt to determine aircraft position and location, will be examined for malfunctions prior to impact.

The CAB had more than 250 per-

sonnel on the air at the time of leaving impact, according to the report. The right aileron was displaced downward one third of its travel by the time the right wing struck. The elevator and rudder surfaces were deflected prior to impact but their positions at impact were undeterminable.

There was no evidence of any transverse shear prior to impact with the water," the report said. "There is evidence of a foreign object strike on the air scoop for the No. 1 engine. It consists of a dent about one-half inch deep, four inches wide and seven inches long. A jagged edge of metal remains attached to the front of the air scoop. The engine and 90% of the fairing and pylon structure appear to have been removed. All flight control levers had been removed.

"The report said, "The aircraft was in the scoop prior to the point on which increased air impact." The three remaining air scoop panels appear to have been bent as a laminar flow sheet. The lack of symmetry between the two sides of the aircraft was noted.

The Structures Group has indicated that all three leading gear was in the full retracted position, the report said. Both wing flaps were at the takeoff setting. It has also been determined that the aircraft struck the water ten feet slightly left were fully and while rotating to the left. The Nos. 1 and 2 engines broke free and over the left wing and the Nos. 3 and 4 broke down and under the right wing.

All flight control surfaces were recovered in the control cables, push pull rods, or linkage from the surface to the boom packages, the report said. All damage was found to be the result of impact forces. The Nos. 2, 3, and 4 engines indicated restricted damage to the compressor sections which remained at one part. The Nos. 2, 3, and 4 propellers

were who were in the summary when the accident occurred have been interviewed and have furnished these details.

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"After assessing this heading," the report said, "the aircraft appeared to settle approximately half of the height it obtained to approximately 135 ft while still in the climb attitude. At this point the nose went up and the left wing dropped to near vertical in the dive, to a wingsup."

"During this portion of the maneuver, the CAB said, "the aircraft climbed to an altitude of approximately 370 ft above the initial position and then began to level off to a wingsup position with the engine still running to the left. The aircraft crashed into the water slightly left of center on a south-north westerly heading."

## DC-8 Charges Against Earnings Approach \$300 Million Level

Douglas Aircraft Corp. drew new the \$700 million mark last week with an total DC-8 jet transport charges against earnings which exceeded those of the Douglas' largest aircraft, the DC-10.

The large regional and smaller freighter unit has been developed for the Nos. 2 and 4 engines and is being analyzed, but that no foreign matter was found in the No. 3 engine. However, feathers were found in the generator of Nos. 1, 2 and 4 engines. The No. 3 engine generator had not yet been disassembled.

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The CAB had more than 250 personnel who were in the summary when the accident occurred have been interviewed and have furnished these details.

Douglas' financial statement is:

	Quarter	Year-to-date
Sales	\$14,893,000	\$91,502,500
Net Profit	(\$1,303,560)	(\$1,303,560)
Net Income	\$1,190,440	\$1,190,440
Dividends	(\$1,190,440)	(\$1,190,440)

The full-quarter change against earnings should make possible a return to profitable operation in the fourth quarter and in 1981, the report said.

Douglas plans to sharpen the DC-8 wing leading edge, and extend the entire wing chord 4% (AVW Oct. 24, p. 41) and this may account for the future DC-8 costs written off in the third quarter.

The DC-8 represents perhaps the largest investment ever made in a single aircraft type to come from the aircraft industry. It is a government contractor, the third largest developer and manufacturer more than 1,000 aircrafts of various types, and it has held a competitive position of unprecedented lengthness." Douglas reported continuing to do large contracts of DC-8 aircraft, which now total about 40 and are valued at approximately \$15 million Douglas expects an equal amount of such business in the future.

One competitor is Douglas, and for other commercial jet transport builders who have taken similar recent charges, and some have faced price cuts that add to net losses. Douglas estimates \$15,000,000 in net losses for the main aircraft of 1980.

Douglas' net worth after deduction of the non-aircraft loss total at \$116, 916,112 giving Douglas capital stock a book value of \$11, a share. Current price of the stock is \$27 a share.

### Wrong Airport

London—Pan American Boeing 707-320 flight from Frankfurt to London landed by mistake at Heathrow instead of Gatwick, causing a 10-minute delay in departure. The airline said the mistake was made because of the complex London Airport weather conditions that apparently were blamed.

The pilot, Capt. Werner Böhl, said the error was due to a close similarity in both airports and memory impairment at both airports. He liaison was re-enacted immediately following an announcement by the airline, and no disciplinary action was taken against him.

The Nos. 2, 3, and 4 propellers



**POWER TO FLY...POWER TO PROTECT...** by Pratt & Whitney Aircraft. Today the Strategic Air Command's Boeing B-52 bomber has a new profile. Instead of its J-57 turbines, two more Pratt & Whitney Aircraft jet engines have been added - a pair of J-85s. Their engines power the North American Hound Dog guided missile, designed to deliver a nuclear warhead behind enemy lines at supersonic speed. And for faster take-off, the power of the twin Hound Dogs augments the thrust of the B-52's eight J-57s. Also, both the bomber and its Hound Dogs can be refueled from aerial tankers. The application of the J-85 jet engine to the Hound Dog missile is another example of Pratt & Whitney Aircraft's expanded activities in new fields of power.

**Pratt & Whitney Aircraft** East Hartford, Connecticut/A Division of United Aircraft Corporation

## BAC Pins Production Hopes on VC.10

Weybridge, England-British Aircraft Corp. is putting its chief hopes for continued aircraft production through 1965 on a family of five second-generation jet transports based on the standard VC.10 design now being built for British Overseas Airways Corp.

Fist of the new transports is scheduled to be next year and is third aircraft off the production line in 1965. Sir George Edwards, managing director of BAC, told *Aerospace* that production is scheduled to commence with the anticipated need by mid-year of major equipment purchased by airways.

This is the way BAC is placing production of the VC.10 series at the Victoria-Airways plant here. ■ Mockup of standard VC.10 has been completed and fuselage and wing sections are now on the assembly line. British Overseas Airways Corp. has ordered 31 of this model. A long-range aircraft capable of operating over stage lengths of 2,000 miles, each from memory points as short as 7,000 ft., the VC.10 is designed for BEAC's Far Eastern routes where airports are in hot climates or at high altitudes, or are located on narrow strips. It will carry a 50,000-lb. payload, including passengers, 40,000 cu. ft. cargo, luggage, provisions, or other stores, at a range of 6,000 miles. Seating 100 passengers is required. Aircraft will be powered by four Rolls-Royce Conway RCo 42/1 bypass engines of 15,000 lb. thrust each. Work is now on the development stage. Engines will be star-mounted on the fuselage.

■ Super VC.10 is a stretched version of the VC.10 and is designed for gate-to-gate operations over long distance routes such as the North Atlantic for BOAC, which has ordered 10 of the aircraft. Fuselage has been extended 20 ft.-28 ft. in a forward of the wing. Capacity is set at 120 economy class passengers (AWM Oct. 10, p. 47). Power will be the same as the standard VC.10. Project design work on the engine has been completed. Both aircraft will be powered by Rolls-Royce RCo 42/1 Conway bypass engines developing 12,500 lb. thrust each. This VC.10 freighter will have a maximum cargo payload of 95,000 lb. in which can be carried over a 2,310-mile route with two hours of reserve fuel. The super VC.10 will have a maximum design payload of 98,250 lb., which can be carried over a range of 2,150 miles with a two-hour fuel reserve. Using AW Transport aircraft costs, the VC.10 freighter will have minimum operating costs of \$17,000 lb. and maximum fuel economy will be 14,000 lb./hr. Super VC.10 will be 856 ft. long.

■ BAC now plans to build for the U.S. market with a still larger model of the VC.10 which engineers have called the "super-super" VC.10. Sir George Edwards and the airplane's still on paper but is being designed to operate over ranges of 6,700 mi. so it can serve service schedules between mid-continent points in the U.S. and mid-continent points in Europe. Fuselage will be increased 9 ft. 8 in. in length. It will accommodate 222 passengers and will have a payload of 15,000 lb. and a maximum takeoff weight of 360,000 lb. The engine will be powered by four Rolls-Royce Conway Stage 7 bypass engines producing 24,000 lb. sea level static thrust each, also as the development stage. Fuel capacity will be 24,000 gal. with the addition of wing top tanks. Pan American World Airways is especially showing considerable interest in the aircraft.

■ Engineers are now sure that BAC will benefit in VC.11 aircraft from the experience gained in the VC.10 design for intercity high-speed transport. Trans-Canda Air Lines and at least one U.S. carrier have individual interest in entering the aircraft if it goes into production. Although these orders would not be sufficient to provide a lucrative future for the manufacturer, they may be considered adequate to justify the research involved. The VC.11 will be powered by four Rolls-Royce RB.165 bypass engines of 11,000 lb. each. It will have a maximum payload of 26,700 lb. over a maximum range of 1,390 mi./hr. Capacity will range from 84 to 110 passengers depending on configuration. Design will be exactly the same as the VC.10 models.

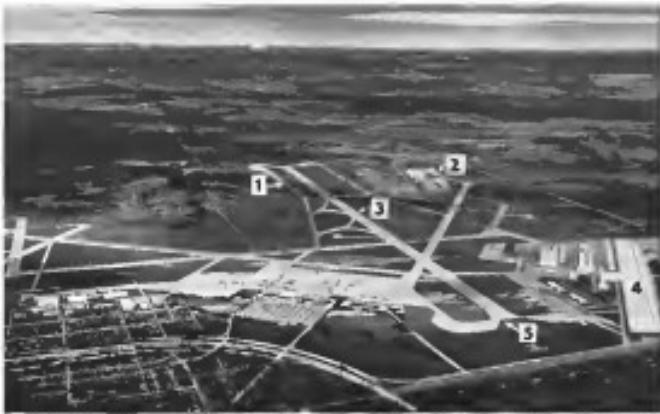
Fifth model of the VC.10 family is the freighter, the first aircraft version of the aircraft, due in 1967. Project design work on the engine has been completed. Both aircraft will be powered by Rolls-Royce RCo 42/1 Conway bypass engines developing 12,500 lb. thrust each. The VC.10 freighter will have a maximum cargo payload of 95,000 lb. in which can be carried over a 2,310-mile route with two hours of reserve fuel. The super VC.10 will have a maximum design payload of 98,250 lb., which can be carried over a range of 2,150 miles with a two-hour fuel reserve. Using AW Transport aircraft costs, the VC.10 freighter will have minimum operating costs of \$17,000 lb. and maximum fuel economy will be 14,000 lb./hr. Nose is opened and closed by a hydraulic gear mounted externally from the front fairing. Nose is swiveling on two large pivots on the starboard side of the plane, the lower being carrying the front load and the top hinge the main load.

### Production Plans

Supplementing the VC.10 series in production plants during the next four years is the VC.10T - a two-engine jet transport designed as a replacement for the Viscount and the Comets 4H (IAW Oct. 10, p. 45). Sir George said that this is part of the company's plan to keep production rates high. The company's success in creating better high Mach characteristics as a result of a delta wing and allowing use of full span leading edge high-lift devices or counter-rotating trailing edge for high lift at comparatively slow speeds.

He referred to such "improvements" as reduced take-off run, no ground-pod clearance problems, better climbing characteristics and basically wide areas of gravity margin providing easier load planning. Sir George stated design factors with transonic aircraft on grounds that such a design is too costly for subsonic aircraft in scheduled operation and lacks sufficient power for long-range operation.





**FACILITIES** expansion at Tulsa Municipal Airport includes (1) new terminal; (2) American Airlines overflow base; (3) high-speed jet apron; (4) Douglas Aircraft plant and (5) instrument landing system runway. West side of field will be devoted to business aircraft.

## Tulsa Spending \$10 Million on Airport

By Ervin J. Bellan

Tulsa, Okla.-Expansion program totaling nearly \$10 million is under way to modernize terminal and operating facilities at Tulsa Municipal Airport. It has completed and an open since January, 1967, the new terminal will increase passenger capacity at the field and now has double current gates in addition to improving present runway by providing a snow-free disposal site for runway grit-preserved operations.

In addition to providing increased facilities for airline tenants at the field, the modernization program is expected to be a boon to business plane operators at the airport by giving them additional space.

Construction for a new 165-foot-tall control tower, in spite of many repeat bid structures, has been awarded to the new terminal building, including a holding and baggage claim wing and a section of steel for the east connector, will begin immediately, with that facility's west connector going up Oct. 20. A new control tower, approximately 137-ft. tall, will also be erected at the southwest corner.

Considerable expansion in passenger operations is planned for the field. Last year total air passengers, nearly evenly divided between arrivals and departures, were handled through the airport, plan to have space at the old tower to Federal Aviation Agency for use as communication offices.

Some 188,215 sq. ft. of space, and a year 10,000 sq. ft. square, air cargo building will be erected adjacent to the structure. The present terminal, built in 1941 with the first addition made in 1946, contains some 35,000 sq. ft.

It has seven gate positions, the new building will provide 15. The terminal is being designed so that passengers will leave a walk of less than 1,000 ft. from the center of the structure to the fifth-gate position. Commercial aviation will be able to handle luggage of three airlines simultaneously. Adjacent to the new terminal will be an 800-car parking lot, which will be capable of expansion to another 800 spaces.

Some 1,200 ft. from the terminal, a 50,000-sq. ft. will be erected by American Airlines, Inc., will walk to start on the facility in 90 days.

A new control tower, approximately 137-ft. tall, will also be erected at the southwest corner. Considerable expansion in passenger operations is planned for the field. Last year total air passengers, nearly evenly divided between arrivals and departures, were handled through the airport, plan to have space at the old tower to Federal Aviation Agency for use as communication offices.

The new terminal, however, will provide a gate for business aircraft users, as it does now at the present building, to facilitate transfer of executives who wish to transfer at the airport with scheduled airlines, and with the new facilities opening, will permit each operator about air more 200 business aircraft based at the field—well past the current seat rate of the airport for this year.

Nevertheless, to parallel the main runway, which has instrument landing systems and sequence lighting approach and landing lights, is designed with high-speed turnoffs for jet aircraft. Tulsa Municipal experts have selected jet operating at the field next year. The airport already is the scene of considerable jet activity, since American Airlines has its main overland base on one side of the airport and Douglas Aircraft Co. maintains a Boeing B-57 overhaul base on another side.

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**ARTIST'S CONCEPTION** shows design of new Tulsa airport terminal; new traffic construction; layout provides for 16 gate positions.

Handling some 540,000 passengers annually.

handle their own fueling operations.

The authority has strong feelings because the city is decidedly antagonistic toward the city is shown in its extension to the business floor. In 1958 the Authority established a separate port facility, Interstate Airport, to oversee the growing load of private planes due to real estate development. Interstate Airport, which now has some 48 business and private aircraft based there, has operated on the block for a net of about \$3,000 per month since the city sold away of its share. The city has an investment of approximately \$1.5 million in this field.

## Ethiopians Plan Trans-African Link

**CAIRO, EGYPT**—Ethiopian Airlines is seeking help to inaugurate a trans-African air service which will directly link the four major East and West Africa cities for the first time Eritre and West Africa.

Ethiopian Airlines officials, meeting at Cairo and the first flight has been set for Nov. 5. Route will look up Addis Ababa, the Ethiopian capital, and West African ports on Nigeria, Liberia and Ivory Coast. From there, moreover, will be able to cross the Sahara desert. Passports are required on Africa's West Coast route. African East Coast ports on Western Pacific Africa, which for years has been largely operated by Trans World Airlines under a management contract with the Ethiopian government, plan to use Douglas DC-8s.

Flight would leave Addis Ababa on Tuesday for Khartoum, Sudan. Next leg—some 1,200 mi.—leads across Africa to Lagos, Nigeria, on the West African coast. At the moment, bilateral discussions on self go on between Ethiopia and Nigerian governments over passenger rights. It is expected an agreement will be reached in Nov. 6 or 7, after which Lagos will be used as technical stop.

To retain the hub configuration, the airport's largest routes, namely, either London or Paris to one of the operators and then another to another, will be maintained. It is expected an agreement will be reached in Nov. 6 or 7, after which Lagos will be used as technical stop.

After Lagos next regular planned stop will be Accra, capital of Ghana. Flight will terminate at Roberts Field, near Monrovia, capital of Liberia.

Ethiopian government is interested in the new route by political reasons, as well as commercial. With most areas of the East and West Africa nations becoming independent, there is a strong desire for Ethiopia, one of Africa's oldest and most stable, to continue association with its neighbors. Addis Ababa government, for example, considers national airline to play an important transportation role as the Congo did.

In addition to such political motives, Ethiopian officials believe a market exists in Africa which they consider has good deal of traffic. There is a good deal of traffic, for example, between the Middle East and West Africa. With its own assets, Ethiopian Airlines expects to provide the market with the most direct air route between the Middle East and West Africa.

Moreover, Addis Ababa is becoming the center for United Nations' territories and to the whole of Africa. This single airline is expected to greatly assist in creating trans-African traffic over the next few years.

# BOAC ORDERS 10 VICKERS SUPER VC 10's

# FROM BRITISH AIRCRAFT CORPORATION!



BOAC has followed its contract for 35 Vickers VC 10 jetliners by ordering from British Aircraft Corporation ten Super VC 10's—aircraft which are tailor made for high density routes such as the North Atlantic.

In an economy class layout the Super VC 10 can carry up to 212 passengers plus 4 tons of freight non-stop from London to New York against strong headwinds.

Both Vickers VC 10 and Super VC 10 with their new look clean wings and rear-mounted engines will offer airfield performance and a cabin comfort which will make them the most passenger preferred long haul jets in operation.

**VICKERS**  
**SuperVC 10**  
POWERED BY FOUR REAR-MOUNTED DOLLS-ROWE GEMINI 80-PASS. FANJETS  
MEMBER COMPANY OF BRITISH AIRCRAFT CORPORATION

# AIRLINE OBSERVER

► American Airlines officials are discussing the Concorde Mark VIII tour, powered by General Electric CF307-2A fan engines (AW Aug. 5 p. 53), with Sud Aviation in France. Fleet of 90 is under consideration. Concorde is currently specifically designed as a trans-oceanic transport for its medium range jet requirement. The Concorde 60 is a flying prototype (AW Aug. 1, p. 40).

► Although Russia officially denied guarding its IL-8 aircraft (transports) (AW Oct. 18, p. 37) the behavior of the Soviet press, coupled with reports from U.S. observers in Russia, prove ample evidence that the aircraft had been set aside. Used about Sept. 1, IL-8s were specifically mentioned whenever they carried important persons into or out of Moscow. A complete blockade of IL-85 aircrafts then began and continued until mid-October. At that time, Soviet newspapers took the silicon by reporting that Hungarian Premier Janos Kadar flew home from Moscow in an IL-8 and that another special IL-8S flight carried Russian doctors and nurses to Kabul, Afghanistan, to combat a cholera outbreak—evidently the European war was back in session (AW Oct. 24, p. 39).

► Negotiations between the U.S. and India on improvements to the bilateral air transport pact have been broken off because of India's refusal to accept U.S. aircraft models that compete with Indian aerospace interests. It appears U.S. efforts to be徒劳的. U.S. caught in a no-win situation in the matter of available aircraft into India from 10 to 18 weeks, but the Indians held that they could not accept the rules of traffic control license agreements with other countries contrary to their interests. Meanwhile, citizens are strong that India will be granted permission to add Moscow as an intermediate stop on Air-India's U.S. India route.

► Federal Aviation Agency has assigned Britain, Canada, Ireland and Portugal to participate in a project designed to determine air traffic control capacity requirements on the North Atlantic for the 1985-70 period.

► Flight Engineers International's Alan President Ron Brown has charged that flight crews unapologetically caused by infra-red introduction of jet engines is responsible of cockpit fires. He said the number of crew fatalities reported to lose through fatigue during the entire period of transition in jet aircraft have lost their jobs at the halfway point of the jet changes.

► Progressive transport aircraft will lead the list of items scheduled on the agenda of International Air Transport Assn. Technical Conference slated to begin April 17 in Montreal.

► British Airways will reduce its current fares on U.S.-Latin American routes 15% effective April 1 in accordance with agreement reached on the Bureau of Air Transport Assn. traffic conference at Cannes (AW Oct. 24, p. 41). First class fares will be reduced up to 10%. Fares are subject to government approval.

► Czech Air Lines has received shareholder approval to increase authorized common stock from 2 million to 4 million shares and to convert three outstanding classes of stock into one new class of common. New certificates for Class A and B stock and general common stock will be issued as a one-for-one basis.

► Allegheny Airlines is now reporting loss of the five Convair 580 intercity transports it has on order. The carrier reported to the Civil Aeronautics Board that the five will still receive initial operating costs of \$5.36 cents per revenue mile—or 1.5 cents per available seat mile—an regular service. Nijkerk Engines, Inc., is now manufacturing a spare engine pool and parts supply in Washington for the Elmdor engine which powers the Convair 580. Plans call for an expansion of parts and overhaul facilities in other U.S. cities.

► United Air Lines is debating between a convertible preferred stock or a convertible bond issue to finance its order for the Boeing 727, assuming Boeing decides to build the aircraft. Some form of equity financing appears to be necessary in a market holding nose too robust.

## SHORTLINES

► British Overseas Airways Corp. reports it carried 236,000 passengers on its worldwide routes during the fiscal year ending Mar. 31, 1960, an increase of 26% over the previous fiscal year. Load factor—passenger and cargo—rose 29% to 589 million BOAC aircraft flew 176,524 hr and 31.8 million mi. The carrier has announced it will begin Interflite cargo service with aircraft to continental Douglas DC-7C aircraft with a payload capacity of 12,000 lb. Two of BOAC's DC-7Cs are already committed at the Douglas Aircraft Co. Santa Monica plant to DC-7F cargo configuration.

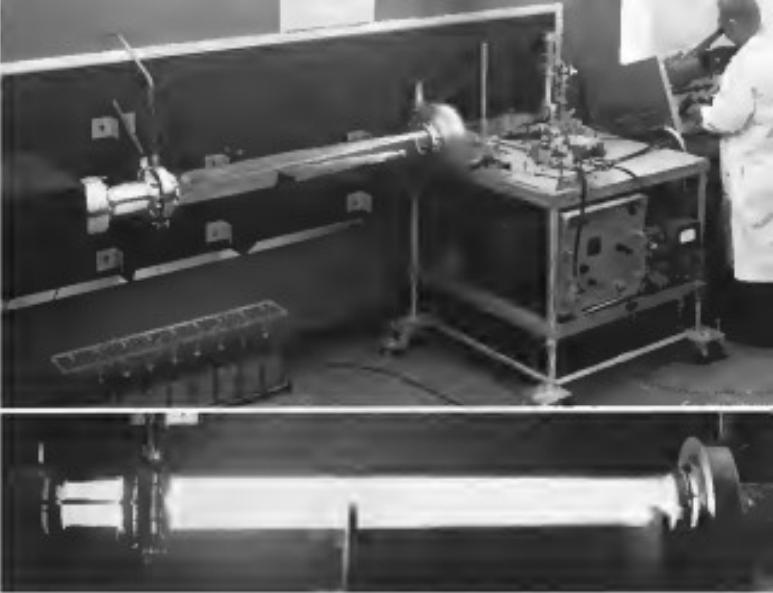
► Delta Air Lines was scheduled to begin daily Convair 580 first class service Oct. 30 from Friendship International Airport, which unites Washington and Baltimore, to New Orleans and Florida. The new service will originate and terminate in Philadelphia.

► Eastern Air Lines' new Douglas DC-8 series between Boston and Miami was scheduled to begin Oct. 10. Service will begin with a daily first class flight via Philadelphia and four roundtrip night coach flights a week.

► Federal Aviation Agency will begin using a new type of written examination for all applicants for Aviation Transport Pilot Ratings. Major changes in the examination concern all problems now dealt with concerned in flight planning, interpretation of weather data, emergency use of radio aids and application of Civil Air Regulations. Applicants who have successfully completed one or more parts of the old sectional examination will be permitted to take the sections which they failed upon if they apply before July 1, 1961.

► Sabena Belgian World Airlines has started marketing in Pratt & Whitney J57P turbofan engines to maintain thrust 17.70 lb in order to enable the Sabena fleet of Boeing 707 intercontinental to take off with increased payloads of cargo while aircraft are not long enough to generate takeoff with a full load.

► Trans-Canada Air Lines has signed a ten-year agreement with the U.S. government which makes under which data aircraft will be loaned to the agency after other passenger aircraft in the Canadian West European sector to make approach with TC-4—the other three are Polair, Canadianair and Yagodina.



**PLASMA AND PROPAGATION** Electromagnetic attenuation as a function of frequency, and magnetic window techniques to alleviate the propagation problems, have been predicted and verified with the Bendix electrically-excited shock tube. These are the keys to future communication with hypervelocity vehicles. Career positions are open in both theoretical and experimental plasma physics, and communications.

**BENDIX SYSTEMS DIVISION**  
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## AVIONICS

# NOW...LIQUID HYDROGEN

from the first privately owned plant

With a capacity of 13,000 lbs./day, the new LINDE liquid hydrogen plant at Torrance, Calif., is prepared to meet current requirements. This important liquid fuel is available in tonnage or liter quantities, for operations or research.

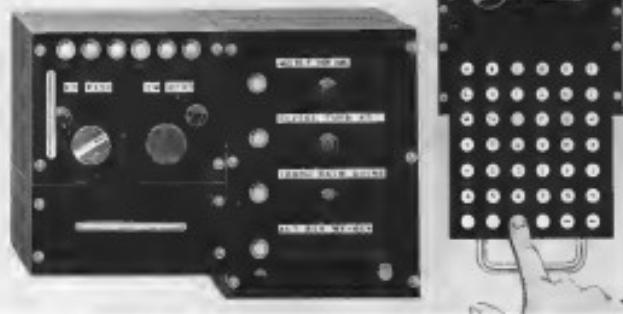
The new Linde plant is the first privately-owned large liquid hydrogen plant in existence. Designed, constructed, and operated by Linde engineers, financed by LINDE capital, and implemented by LINDE delivery and storage facilities, it marks a long step forward in liquid hydrogen supply.

The product delivered from this new plant contains less than two parts per million in impurities. It is suitable for all purposes including fuel, laboratory experimentation, or engine testing. Distribution to tank trucks and containers insulated with LINDE super-insulation keeps losses remarkably low.

For additional information on this new Linde facility and its products, write Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N.Y. In Canada, Union Carbide Canada Limited, Linde Gas Division, Toronto 12.

**LINDE COMPANY** UNION CARBIDE

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**DATA LINK** for SAC bombers and tankers is expected to prove fast, secure point-to-point communications. System developed by General Electric, it is called Digital. In recent test, test pilot using console 1042 and message display monitor (center) while top gun displays "return" messages while those lower show digital teletype format messages. To send message from aircraft to ground, pilot would use pushbutton computer (right) located in withdrawable panel underneath left console.

## GE Tests Air-Ground Data Link for SAC

By Philip J. Kline

Lynchburg, Va.—A digital communications system is being tested to improve the speed and reliability of Strategic Air Command's ground-air communications links with its B-52 flying bombers and tankers, began its evaluation test here this month. System was developed by General Electric's Communications Products Department here.

Using the new data link, a SAC command post will be able to transmit messages in digital form over existing Short Order single frequency radio circuits which will be disclosed in the course of a special display group of aircraft in the wings of all SAC strength in mid-November.

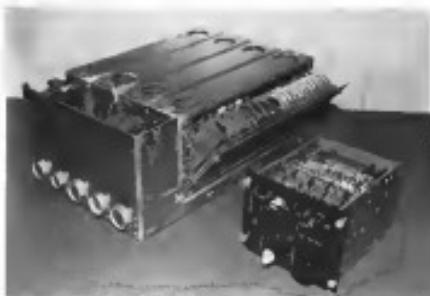
The digital communication message are expected to get through under a wide range of propagation conditions earlier than such a signal might in terrain-penetrating wave communications according to George Scherer, Wright Air Development Division's Communications Laboratory.

An equally important gain from digital communications is expected when SAC gets its new automatic control via its TACAN/LI using long-ground-based digital computers installed in USAF bases.

20 p. 1311. Digital communications system, test aircraft equipped and ultimate recipient will enable SAC Central System computers to integrate assault and defensive data pro-

cesses and store without human action or intervention in the aircraft or on the ground.

The new testbed SAC data link, called Digital Selective Communi-



**SELECTIVE CALLING UNIT**, a portion of complete Digital system, weighs about 21 lb. including control console (right), but production unit will weight about 10 lb. GE will soon begin evaluation tests with airborne units later this next summer.



# Flight Propulsion NEWS

A report about progress in research and products from the Flight Propulsion Division of the General Electric Company



General Electric's Caravelle is currently being converted to CJ-855-25 aft-fan engines at Edwards AFB, California. Production aircraft have been designated Caravelle V3.

## General Electric Caravelle Begins Conversion to Aft-fan Engines

**EDWARDS AFB, Calif.**—The General Electric Caravelle recently arrived at the Flight Test Center here to begin conversion to the CJ-855-25 aft-fan power proprietary to flight testing. The program calls for retrofitting the first V3 with first flights scheduled in December.

The GE Caravelle arrived after carrying over 3000 passengers during a 16-city sales tour conducted by Douglas Aircraft Company. Douglas will sell and service the Caravelle in the United States and Canada.

The first two CJ-855-25 engines, originally in the Caravelle program are on hand awaiting modifications, with the smaller size engine heavily instrumented. CJ-855-25-powered production aircraft have been delivered the Caravelle V3 by Sud Aviation.

Each of the CJ-855-25 engines will produce 16,000 pounds static thrust to boost Caravelle speed and range. The new powerplants will also provide reduced sound levels and shorter takeoffs and landings.

**CJ700 Completes Two 150-hour Runs**

**LYNN, Mass.**—General Electric's CJ-700 aft-turboshaft engine recently completed its second unmodified 150-hour endurance run in less than a month.

On both occasions, the powerplant delivered maximum thrust and specific fuel consumption. Guaranteed specific fuel consumption of the 4000-hp powerplant engine is 0.6 lb/lb hr.

Initial testing of the CJ700 began in mid-May. Throughout the test program acceptance, the engine has met all performance requirements.

Fight test support was scheduled for availability in early 1961. FAA-certified engines are a year later.

For more information about the CJ-700, check GED-6194 and GED-6196. See coupon.

## CT58 Certified for 1000 Hours TBO

**LYNN, Mass.**—General Electric's CT58 turboshaft engine recently became the first helicopter powerplant to be certified for commercial operation with Federal Aviation Agency approval for 1000-hour time between overhaul.

The 1000-hour rating, representing more than a year of normal operation, is the longest TBO granted by the FAA for evaluation of TBO of other helicopter engines. The new ratings apply specifically to the Sikorsky S-51, which recently became the first American helicopter to be certified for commercial operation.

The CT58, military counterpart of the CT56, passed its certification test in August 1958. The CT58 recently passed a soiled Navy HSS-1B helicopter more than 1000 flight hours without overhaul, operating about three hours a day for a full year. Parts and components were well within wear limits.

The CT56 and CT58 engines power a broad range of medium commercial and military aircraft.

For additional information on the CT58 turboshaft engine check GED-597A. See coupon.



CJ58 powers the Sikorsky S-51, first American helicopter certified for commercial operation.

## Nuclear Flight Propulsion Group Joins FPD

In a move to align operating groups more closely with customer needs, General Electric's Aircraft Nuclear Propulsion Department has been assigned to the Flight Propulsion Division. General Manager is Harry P. Black, who reports directly to John H. Manganaro, manager of the division vice-president.

ANPD has been engaged in the development of military nuclear aircraft propulsive powerplants since 1951. Successful ground tests of reactor and engines have been achieved since 1956 in a direct or cycle system.

For information on approaches to aircraft nuclear propulsion, check GED-1364. See coupon.

## A3J Completes First Carrier Trials

**EVERDALE, O.**—The Navy's North American Avistar A3J Vigilante powered by two General Electric T70 engines, recently completed the first phase of its carrier suitability trials.

The weapons tests were conducted aboard the USS Saratoga off Miramar, Fla. The Vigilante made 25 catapult launches and 14 arrested landings during its first carrier demonstration. Preliminary Vigilante performance with several "touch and go" landings and the glass was given general carrier suitability checks, including timing and spotting.



All catapults from the USS Saratoga, powered by two GE T70 engines.

The sleek Mach 2 bomber's T70 engines have the highest thrust-to-weight ratio in their class and provide low specific fuel consumption. The T70 produces more than 16,000 pounds of thrust, yet weighs only about 1600 pounds.

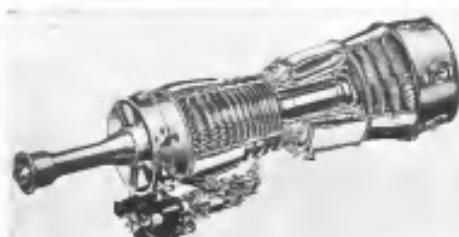
## B-58 CREW WINS SAC BOMBING TROPHY

**HOBARTON, AFB, Tex.**—The T70-powered B-58 Hustler, first USAF Mach 2 bomber, recently demonstrated outstanding capability in its first SAC bombing competition.

In the bombing competition, top individual awards were received by Major James C. Conner and the crew of the B-58 equipped 30th Bomb Wing. The Wing, which flew from the Barksdale Air Force Base, Louisiana, was the overall competition winner. The division vice-president of the 11th Bomb Wing, was B-57's of the 11th Bomb Wing.

The unit bombing competition was won by 11th Bomb Wing, while T70-powered B-57's of the 340th Bomb Wing took the navigation award.

Aided by the B-58's ability to start an J75 powerplants while flying after carry-over of the number one engine, the Hustler crew swept the ground start timing competition.



Closeup view of General Electric's T84 turboshaft configuration, which exceeded all guaranteed specifications in preliminary flight rating test.

## T64 Turboshaft Engine Exceeds Pre-flight Rating Test Guarantees

**LYNN, Mass.**—General Electric's T64 turboshaft engine recently passed its official preliminary flight rating test (PFRFT), exceeding all guaranteed specifications.

GE's Read Aircraft Engine Department, with Navy concurrence, can thus officially test on this version of the T64 gas turbine, two on JP-4 and one on JP-5 fuel. In each case all performance parameters, including acceleration times, of course, starting times and duration, were well within specification limits.

The engine developed 2160 shaft horsepower at military rating with a specific fuel consumption of 0.450 lb/lb hr., as compared to its performance guarantees of 2050 rpm at 0.500 lb/lb hr.

Test approval of the T64-2 turboshaft substantially qualified the powerplants direct drive version, the T64-0, for flight testing.



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Major Conner's winning time was two minutes, twenty-five seconds from class to tax.

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Aircraft Nuclear Propulsion	
Sales Dept. R. A. M.	
GED-6194 and 6174 "CT58" Turboshaft	<input type="checkbox"/>
GED-6194A "CJ58" Turboshaft	<input type="checkbox"/>
GED-6195 "T70" Turboshaft	<input type="checkbox"/>
GED-6196 "T84" Turboshaft	<input type="checkbox"/>
GED-6197 "T64" Turboshaft	<input type="checkbox"/>
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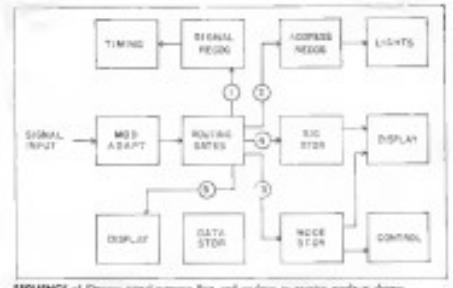
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SEQUENCE of Dione signal message flow and address to receive mode is shown

now, or Dione for short, will provide the following services:

- "Cancel" messages, consisting of 36 (or more) continuous word intervals synchronized or triplet.
- Variable length messages containing up to 45 alphanumeric characters, for special communications situations where constant intervals are not suitable.
- Request for voice contact, showing specific line that usually should contact.
- Automatic switching function which causes a ground station to activate deactivation of transceivers or equipment aboard the aircraft or change its operating mode such as IFF identification friend or foe). This service switch will be used to obtain automatic altitude and position reports from aircraft navigation equipment.

The GE system enables individual bandwidth (under 1000 Hz) to also become expandable or flexible format messages in digital form to an unlimited ground stations).

The GE Dione system has several characteristics such as flexible format message structure and variable-speed data rate (100 bits per second), which could make it attractive for civil as well as several military airways like the Air Transport Avia, a strengthen existing direct view on civil data link needs, although the AG-MCS data link being developed by Radio Corporation of America under Federal Aviation Agency sponsor does promise a helpful flexible message capability and resulted in an extremely high data rate (100 W bps at 20, p. 58).

### Prototypic Airborne System

The prototype airborne Dione system which GE has constructed for evaluation with weighs approximately 68 lb. Because equipment was developed on an extremely short timetable of about one year, it does not represent the ultimate in miniaturization. A pro-

duction redesign should present the airborne system weight to be cut to about 55 lb, according to G. A. Ross, Dione project manager. The system is completely transistorized, Ross reports.

### Dione Fundamentals

For maximum flexibility in application and use, the Dione system has been designed in the form of two basic subunits:

- Selective calling, called control mode for group LAN/UBA 2D, which enables ground station to also individual group or all aircraft and transmit up to 636 discrete messages or switching commands.

▪ Digital message unit, called digital data group LAN/UBA 2B, which can be used to selective calling whenever to provide for two-way digital communication of both encoded and decoded for user messages.

In the prototype configuration, the airborne selective calling unit and its associated rugged control/display console weighs about 25 lb. The digital message unit and its cockpit message console of both encoded and decoded for user messages.

In the prototype configuration, the airborne selective calling unit and its associated rugged control/display console weighs about 25 lb. The digital message unit and its cockpit message console of both encoded and decoded for user messages.

Selective calling, from ground to air or vice versa, is accomplished by transmitting a series of four null tones which correspond to the specific code assigned to individual aircraft groups in the air traffic. The four letters assigned can be a phonetic expression of the aircraft identifier, would be transmitted and received by hearing tone or completely other tones. For example, code letters for SAC Headquarters might be GFHT, or GCTV.

When ground station transmits a call to an individual aircraft group, if successful in the receive mode, the cockpit displays of aircraft being called will start flashing. The particular loop chosen will indicate whether the call is



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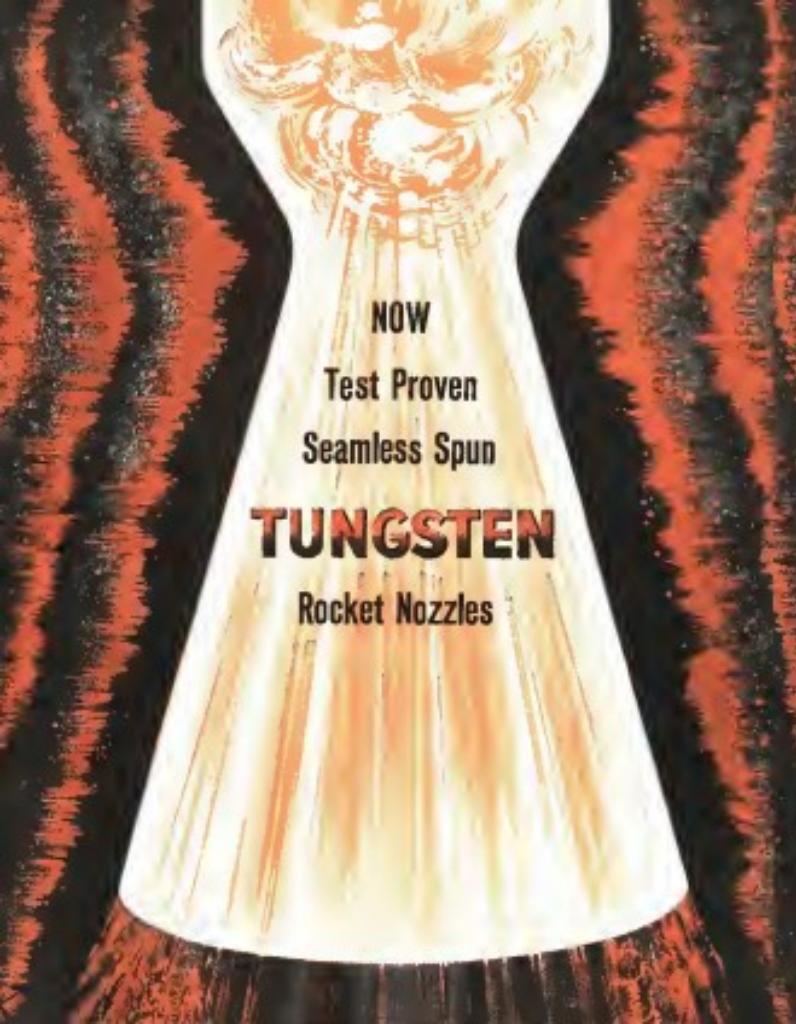
VEECO's MS-9 leak test stations are used to measure, vacuum and inside out test hermetically sealed units. The bellows mass spectrometer permits sealed objects to be tested leak proof at a sensitivity of  $10^{-10}$  std. cu. cm.

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**40 KW PLASMA JET (CENTER)** — Temperatures up to 30,000°F generated by plasma flame may be used for applying ceramic, metal or ceramic coatings.

**TM-5 TEST MACHINE (BOTTOM)** — The auto dynamic ultrahigh-temperature testing machine contacts bimetal, three, sheet-metals, compression tests of metals at temperatures up to 3,000°F. Programming of resistance heat temperature time parameters may be performed.



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radiohead group on a general broadcast. When the pilot pushes the flashing light, causing it to go out, Deimos transmits its return acknowledgement signal containing ascent altitude code back to the ground station.

windows on the panel will display an entire tree of which represent one of 576 possible discrete messages which the remaining five letters identify the general station calling. The letters are displayed by means of an individual transmitter device, one for each letter. For

If an aircraft wants to send a selective call to a specific ground station the operator uses the bar code keys to set up the desired radio-link message code and the station identity code in the right-hand (T/R) window. He then selects the radio channel on which he will be transmitting and finally pushes the transmit button. During transmission a single reflected, natural high frequency (NHF), an electronic beacons

The identity of the calling aircraft and its two-letter coded message, will then appear on a display console at the ground station. When the ground station operator acknowledges the call, the "Ack" light in the airplane console will flash.

## Digital Unit

Although the selective calling and re-letter mode code permits transmission of up to 476 prioritized codes (26x26), it requires the use of a code book which is an encumbrance in itself. With the addition of the digital message code and its display/comparing console, the system gains availability and speed, but at the expense of added equipment weight and cost factors.

The digital message console displays both narrow and flexible format type messages received from the ground and also is used for composing messages sent

Then the screen is cleared to the ground.

Behind the big display slot we have three frames, each with 16 positions arranged in a grid, upon which one or several frequently-used words are printed. To select one of these 36 positions in the first display, and the word displayed, is necessary only for the general selection to present a single alphanumeric character, immediately following its selection selective or filing code transmission. The 20 different letters plus 18 different numbers provide for the 36 different frame positions.)

### Rapid Transmission

In incorporating a series of three dipole-dipole characters, the ground stations are positioned such that the three stations to display one of the control messages. The control channel message is passed out about each half second to transmit in addition to the several seconds required for the initial selective call.

The new thin horizontal slots on the console are used to display flexible front-mount messages. Behind each of the three slots are 16 individual rotatable drums, each with 26 letters and 10 numbers positioned at precision

By transmitting additional alpha wave-like pulses (or spikes) back onto the electric cell, the ground stations are position each of the drivers in sequence.



#### **Tracker to Obtain Satellite Tumbling Data**

Lightweight trailer developed by Ruthen Co. will be used to obtain data on satellite launching so that this information can be considered in design of manned spacecraft and communications satellites. Microsatellites and even tiny cubes can reflect light effectively. Changes in light intensity indicate launching. (See signature below) was reproduced from page of Ruthen Co.'s new satellite trailer. Inspect trailer and equipment as you would a small car; the system can be carried to airport for short time when about to use.

The diagram illustrates a target with several key elements labeled:

- TRACKER AZIMUTH**: A horizontal line extending from the center of the target.
- TRACKER ELEVATION**: A diagonal line extending from the center of the target.
- Target Height Reference**: A horizontal line at the top of the target.
- Target Width Reference**: A horizontal line at the bottom of the target.

### TUMBLING PERIOD ABSORPTION BY CLOUD



## SPARROW III "flies home" on FAFNIR BALL BEARINGS!



<sup>10</sup> See also the discussion of the concept of "cultural capital" by Bourdieu, 1980.



Fafnir Torque Tube Type Ball Bearings less than  $\frac{1}{2}$ " thick and weighing only 4 ounces each, support the wing proto in Raytheon's Sparrow III missile.

To carry loads imposed by wing operation at Mach 2+, each of these Fafnir bearings is fitted with its maximum complement of 45 balls. The bearings also have tight, integral seals of extra-thick Buna N material to withstand the pressures of supersonic flight. These seals provide positive protection against atmospheric contamination and loss of factory-packed bearing lubricant.

Fafnir's experience with bearings for marine, jet engines, and aircraft controls and accessories is unmatched in the industry. Take advantage of it. Look to Fafnir for a *sous* approach to your bearing requirements. Write The Fafnir Bearing Company, New Britain, Conn.

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Ariat's supply of elastic components is vast. At this moment, for example, Ariat's total inventory of accessories is somewhere over 450 million. The manufacturers whose lines Ariat distributes and/or makes available are in constant existence of your personal and apparel requirements. The Ariat System is geared to make your dreams of tomorrow's needs, next season, become reality. Customer-driven. Manufacturers and planners, go on duty.

The new Concept of an overwhelming Supply is one of many advantages in The Avant System. Avant, offering a network of Sales Agents covering the U.S.A. & their expertise has led to success in a Service Center Superstore. Numerous Avant facilities are concentrated strategically throughout the country. Avant maintains and operates complete assembly facilities for Consumer Product requirements. For the most reliable, most convenient, and best source of Supply contact your nearest Service Center in The Avant System.

AVNET



**THE AVNET SYSTEM**  
A Division of AT&T  
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to spell out our Beagle family message with as many right-thinking characters.

For transmitting a stored or flexible format message, the transmission from the aircraft to the ground, a small push button keyboard is pulled out from under the selector calling control panel. By pushing the appropriate buttons, the pilot can issue any message which will be displayed on the digital message console. When a message is completely composed the pilot pushes the transmit button.

If an incoming message is received before the arrival while the pilot is enroute in outgoing one, the incoming message is given instant priority on the display. However, the portion of the outgoing message already composed is stored so it can automatically be subsequently recalled to the display.

Armen Field Guide

DIAcon employs the Army Field Data Relay trials, normally used for tritype, in accordance with Defense Department policy of standbarking on this end whenever possible.

Eight bits are used for each alphanumeric character. Six of these identify the particular character, the seventh bit can be used for control functions or carriage operation, and the eighth bit is a parity check.

For Division, bats are measured by means of frequency shift leaving PSK as a telephone operation. Totals of 3.9, 1.6, and 2.5 hr are employed to indicate "sun" and "airin," respectively.

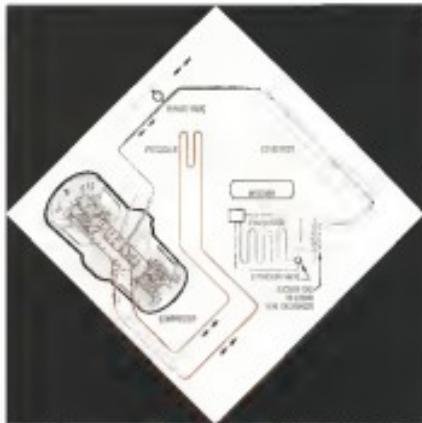
In addition to the partly check, as known in the Army code, Dicode employs considerable redundancy to assure accuracy and reliability under various propagation conditions. For example, in the selective calling portion of the message, the ten-letter call code of the addressee is repeated four times; three joints and the identification of the calling station are also present.

The two-letter switching command is transmitted twice along a message and both must be received in frame by the system to initiate the desired control or display action.

Printed Questions

Operation of the Discos system in the receiving mode, developed by GEC-Koen at the recent National Communications Seminar in Utica, N. Y., is as follows. Audio tones (FSK) representing the incoming message are fed into chips onto digital form by the modulation adapter. The message is then routed to appropriate control circuits.

First of these currents, as regard associations, which identifies pulses as being



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## On Target, Because...

B&L optical-electro-mechanical capabilities help align armament on Polaris Submarines

To sharpen the shooting eye of this deadly fish, Bausch & Lomb developed four different instrument systems to convey optical and electronic information between the missile guidance package and the inertial navigation system.

Accuracy of these systems is measured in terms of one second of arc: 1 part in 200,000.

The integrated skills of Bausch & Lomb sped these four Polaris projects through every phase of development: complete original design, B&L documentation, fabrication, assembly. We'd like to apply the same skills to your project.

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Driver energize and synchronize the timing circuit. Signal is then loaded to the address registers, whereby write operations are made with each of the three cells which individual address capability is set to incomplete, individual group or general.

If the memory address is one of those three, it energizes the appropriate light to start flowing on the analog circuit and signal is then loaded to first register and then to operating stage. Both the mode control and offline status code bytes are then displayed on the console. If the two-letter mode control code indicates that a digital message is to follow, the signal is routed to the proper circuits in the measured digital data group to display on the cockpit console.

Initial tests to be conducted later starting this month will be ground-based evaluations of the software coding subsystem to follow, followed next year by tests on the flight test subsystem.

By mid-1961, Air Force hopes to begin actual flight tests using aircraft flying units installed in about 30 SAC aircraft, none of which will ever be equipped with digital data interfaces. Present plans are to install purchased Drama equipment at five SAC bases.

The Digital Selective Communication system was developed under Wright Air Development Division sponsorship.

### U. S. Plans Tracking Station in S. Africa

Johnson Space-United States and Union of South Africa have signed a bilateral agreement for location of a deep space tracking station scheduled for operation early next year, in Worcester, Transvaal.

The U. S. will put the South African government \$2.8 million for a 1,250 acre site, located 24 miles south of Krugersdorp. Station initially will be operated by U. S. personnel who will gradually be replaced by South African engineers. The site is owned by the state-owned Council for Scientific and Industrial Research.

National Aerospace and Space Administration will set up program organization for maintaining the site which will consist of 35-ft. tracking dish mounted on a 300-ft. pedestal. Use will have an initial range of + and - 100 km.

Under terms of the agreement U. S. firms will build infrastructure and South African contractors will construct facilities.

The deep space network also will include a station in Australia and a site in Goldstone, Calif. The three facilities are about equidistant around the earth to provide complete tracking of space probes.

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One of A.C.T.'s early assignments was a 100% check-out of all 30,000 components in a Univac computer system. Each was checked on 10 parameters — a total of 900,000 critical tests. Many thousands of man hours were

cut to a few hundred hours. Human failings of fatigue and misinterpretation were completely avoided.

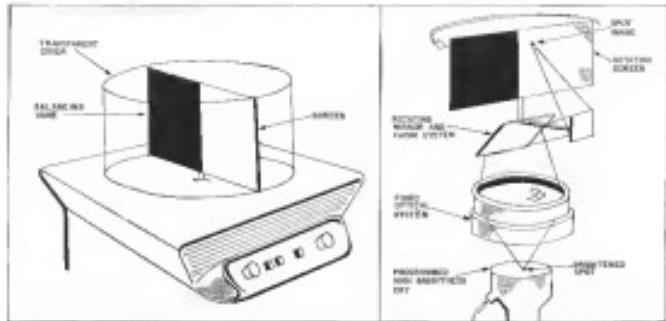
But speed is only one of A.C.T.'s many merits. With great flexibility, it automatically measures resistance, diodes, transistors, capacitors and capacitors with absolute protection against damage during testing.

A.C.T. is currently on its 16-hour day, sun-day work in the continuing mission of Univac reliability.

Univac reliability insures on the creation of A.C.T. Univac ingenuity and capability produced it.

Military Dept., Remington Rand Univac, Division of Sperry Rand Corporation, Univac Park, St. Paul 16, Minn.





**NEW** three-dimensional display for air traffic control or air defense, developed by ITT Laboratories, gives 3-D effect from any viewing angle without need for stereoscopic glasses. Display consists of rapidly-projected pulses of light whose spots are optically transferred to rotating screen which rotates 1280 rpm. Persistence of vision causes spot-projected spots seems to appear in long perspective as points. ITT says new display should be available in first half of 1968.

## New Display Gives Realistic 3-D Effect

Washington—New type of three-dimensional display variable for air traffic control, air battle command or space surveillance, which does not depend upon stereoscopic glasses, has been developed by ITT Laboratories.

Small scale working model of the new 3-D display was demonstrated here recently to representatives of the military services, the Federal Aviation Agency and the National Aerospace and Space Administration.

Novel feature of the 3-D display, which is designed to give the user a clear picture of what is going on around him in perspective and from any viewing angle, is that it is almost as if the air traffic or battle were taking place in miniature within the glass enclosed cylinder. The display needs to be viewed in subdued light to be most effective.

Displays can be produced on a range of sizes, with cylinder diameter of up to several feet, perhaps larger according to Andrew Gerasimov, director of ITT Laboratories' Avionics Laboratory.

### How It Operates

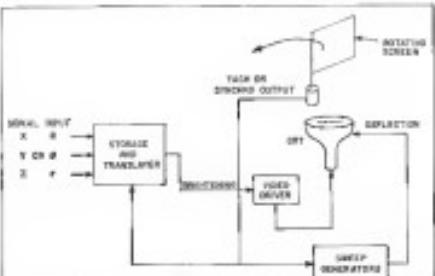
The ITT Laboratories device utilizes a high intensity electron tube, an optical projection system, and a rotating translucent screen within the glass cylinder, all contained within the perimeter of a frame of the human eye to create a three-dimensional display.

The raster-driven screen turns at ap-

proximately 20 revolutions per second. Any bkg. light source, shadow or other designation appearing on the cathode ray tube (CRT) face is optically projected onto the rotating screen.

If the bkg. represents the position of an aircraft, for example, and the cockpit's azimuth position is 90 deg., control circuit cause it to turn 90 deg. on the CRT face and rotating screen at the precise instant when the aircraft is at a 90-deg. azimuth position, disappearing from the CRT and the screen immediately thereafter.

If the bkg. represents the position of an aircraft, for example, and the cockpit's azimuth position is 90 deg., control circuit cause it to turn 90 deg. on the CRT face and rotating screen at the precise instant when the aircraft is at a 90-deg. azimuth position, disappearing from the CRT and the screen immediately thereafter.



**SPECIAL** synchronizing controls are required for cathode-ray tube used with 3-D display. Target spots and altitude coordinates are displayed on tube face, with instant of display corresponding to target's azimuth position, as shown above.

the glass cylinder not bright above its base.

Because of the persistence of vision, the bkg. appears to be truncated to darkened space within the glass cylinder at an azimuth angle and range corresponding to the cockpit's actual position relative to zero.

There is no need to limit the viewing angle to 180°, which can be done with the other three methods. As the rotating screen reaches the zenith position, corresponding azimuth for its image and altitude are briefly displayed on the outside as false and slightly faded in the screen.

The model displayed here, using a spider mounting approximately 12 in. in diameter and six inches high, employed small lamps instead of a CRT for producing target spots. The spots were broader and not as bright as those which should be achievable with a high brightness projection type CRT according to Raymond Bassett of ITT Laboratories.

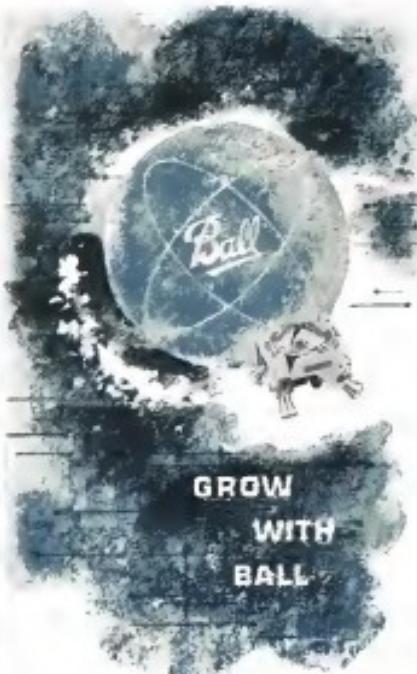
Despite these limitations, the three-dimensional effect was generated and maintained, requiring no special focusing of the eyes or concentration. In the demonstration model, all of the targets were real, even as they appeared to fly through the glass cube, like a butterfly. Because the screen is translucent, the display can be viewed from any outside position.

To achieve magnified focus on the screen, a block of clear glass is attached on the opposite side of the entire device. By placing white grid markings on this block, using, and using a telescope, it is possible to see offset portions of the grid alongside any target and determine its distance.

Any eight separate channels of configuration data can be produced on a cathode-ray tube and displayed on the rotating screen by means of the spots. (See March 1, *Readline*.) It is limited only by CRT spot size and definition, and the quality of the optics used. Bassett said, "Target spots can be created as quickly as in a conventional CRT."

If a colored display is desired, a high-speed color wheel similar to that used in each color television can be inserted between the CRT and spider, suitable modifications to produce nine target bkg. in any color, Gerasimov said.

The 3-D display was developed with ITT funds. Company now is trying to find an interested customer in order to build a fully operable model. This would include the use of a CRT and design of control circuits needed to synchronize CRT display with the rotating screen. Gerasimov estimates that such a model could be built for approximately \$500,000, but less than \$2 million.



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## FILTER CENTER

► **New Elast Techtron—** Convoluted elastomer bellows designed for decompressing nuclear equipment's class 1B and decompression exhaust and circulation-to-waste line has been developed by Electronic Specialty Co., Glendale, Calif. Necessary data can be obtained from a work order, pose, engineer says. Equipment employing the technique would weigh 30 lb, occupy about 1 cu. ft., according to the engineer.

► **Dual-Power Satellite-Earth interface system** which could provide both communications data and emergency communications with a satellite busbar will be proposed soon to a number of satellite agencies by Electronic Specialty Co.

► **Coaxial Shutter Exploded**—The coaxial—a construction of semiconductor isolator—a being investigated by RCA Laboratories in a possible solid-state frequency-selective amplifier. First outlined in the Solid-State Device Research Conference by R. D. Linscott of RCA, the coaxial consists of a semiconductor specimen subjected to a magnetic field and connected through a dc power supply to a load. Frequency of oscillating voltage at the load are determined by impedance and capacitance of the specimen and the distance and the surface condition of the semiconductor. Work is now sponsored by an armament Wright Air Development Division multi-carrier military Multicarrier Transistor Amplifiers and Solid State Amplifiers.

► **West Coast Solid-State Research Conference** began Sept. 16 of West Coast solid-state device research conference got under way at Oct. 20 and 21 in Standard Research Institute Sponsored by the West Coast Subdivision of Solid-State Division of the American Institute of Electrical Engineers and the Institute of Radio Engineers Professional Group on Electronics Devices. The series will explore many facets of research in semiconductors, magnetic and electro optical devices. Meetings are open to scientists and engineers who agree not to photograph slides or take notes so as to obtain final exchange of early and tentative research results.

► **Microminiature Components Division** has been formed by Ling-Temco Electronics, Inc., Bellanca to design, produce and market logic circuitry modules for microprocessor computers, custom acoustoelectric modules and logic and frequency synthesis. Division will be

located in space leased at 1475 St. Menehan Ave., Anaheim, Calif.

► **Air Force** declared the first Ballistic Missile Early Warning System station at Thule, Greenland, operational Oct. 3. Second BMWES station at Clear, Alaska, is scheduled to become operational next summer.

► **General Electric** Marine and Space Vehicle Department will build a solar test facility near Phoenix, Ariz., which will prevent testing of the largest solar-powered space generating systems now being built for space applications. Facility is to be ready by February.

► **Marine Standard Division** of United Aircraft will produce a dual redundant navigation system for the antisubmarine helicopter being developed for the Navy by Boeing Aerospace Co. (AW Sept. 18, p. 17). System would include a navigation plotter, navigation analog computer, ship's course indicator, ship's speed and distance indicators, and flight control units, including ring and bearing transducers.

## NEW AVIONIC PRODUCTS

► **Alpha-Numeric readout modules**, variable from 10 to 110, display on English-alphabet letters and are available from 2 through 9 in characters 3 in high, 2 in wide. Indicating segments are white against black background. Displays in low power dc signal, from 1 to 10 v, with response time of less



than 0.1 sec. Two basic types 285 (horizontal) and 291 (vertical, a pulse-controlled lighting). Modules, which can be fitted together in panel mounted, measure 3.5 in high 2.5 in deep, 2.1 in wide. Manufacturer is Alliant International Corp., 140 E. 2nd St., Monroe, Long Island, N.Y.

► **Voltage-to-frequency converter, called Magewriter**, produces output square wave whose frequency is directly proportional to applied bipolar voltage. Output frequency is within 1% in standard configuration, while "Rod Line Magewriter" has frequency of 4 kHz



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with temperature stability better than 50 pp over 0°C according to manufacturer. Eight standard models provide full range of output frequencies from 100 Hz to 21,000 Hz. Average output power (full scale frequency) is adjustable over a 4:1 range with built-in attenuator. Standard units have input voltage ranges of 0.1, 0.10 and 0.100 v. The static adjustment center measures approximately 11 x 31 cm. in. Manufacturer: Powers Manufacturing, Inc., 518 Penn Blvd., South Minerva, Calif.

• Minimal tape predictor, strength tested for air ground support equipment, operates at speeds from 0-16 mil cent per second on standard tape chart

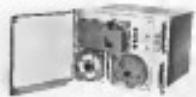


Fig. 5. A, 7 or 8. Predictor is available with predictors for metallized mylar tape. Manufacturer: Telecompacting Corp., Data Instruments Inc., 1235 Santa St., North Hollywood, Calif.



• High-power X-band Myltron, Series VA-549, rated at 20 kw continuous wave (CW), for applications requiring very low AM and FM residual noise is called highest CW power Myltron ever offered for X-band by manufacturer. Klystron cover frequency range of 7.125 to 8.000 mc, are tunable over a 1.5 mil band; parasitic power gain of 17 db, and transmission bandwidth of 50 mc. The waveguides, launch power gains and bandwidths are 45 db and 24 mil, respectively. Units are now being delivered successfully. Manufacturer: Varian Associates, Inc., 610 Harrison Way, Palo Alto, Calif.

• Miniature telemetry power supplies, Type 1124A/1124B, with 15-watt output, weight only 34 oz. Amplifiers operate over entire 215 to 260 mc. weight band at altitudes up to 180,000 ft. Manufacturer: Tele-Dynamics Div., Avco Corp., Anna, Pa., 5900 Parkside Ave., Philadelphia, Pa.



**MOTOROLA** **Military Electronics Division**

Radar-Oscilloscope Camera Processes Film  
Radar-oscilloscope strip film camera processes film under the condition of their unique requirement of processing selection. The variable speed camera, with transport speed range of 0.25 to 12.5 in./sec., was 70 mm. film in lengths up to 100 ft. Cleaning and processing unit weighs 95 lb. Delivery will be available in January. Manufacturer: Chicago Axial Industries, 930 West Northwest Highway, Barrington, Ill.

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# MODERN DEFENSE IS ELECTRONIC

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LEADER OF THE FREE STATE OF SOUTH AFRICA, MR. J. B. ROBINSON, RECENTLY ADVISED THE GOVERNMENT OF THE REPUBLIC OF SOUTH AFRICA THAT HE WAS PREPARED TO SIGN THE CONVENTION ON THE PROHIBITION OF NUCLEAR WEAPONS.

**FREIGHT FORWARDERS** are firms that specialize in moving goods from one place to another. In some countries, such as the United States, the term "freight forwarder" is used throughout the industry, while in others it is used only for those firms that handle international shipping.

## SPACE TECHNOLOGY

## Oscillating-Electron Ion Engine Tested

By Michael Yaffee

E. Fleischman, Conn.—United Aircraft Corp. has invented the fast-growing electrical solenoid propulsion field with an unusual oscillating-electrode beam-hardening ion source that produces a high-velocity, electrically neutral plasma beam.

United's Research Laboratories, which developed the own drive with passenger funds now has a research and development contract from the Air Force Research Division of the Air Research and Development Command to investigate the operating mechanism of the device. This contract is in route for 15 months and, if it is kept, will lead to a development prototype.

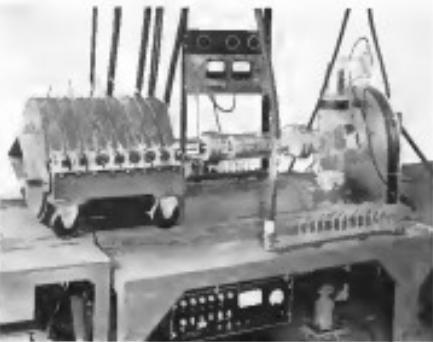
The strengths of UAGC's weapons are such that it appears able to produce an extremely useful bomb. This follows the 'charge-change' effect—the buildup of an electrical charge on the vehicle which would drive the explosive charges parallel back and forth instead of permitting them to detonate simultaneously from the heat generated by power of mass of the effect proposed ion rocket engines. This means that theoretically there is no limit to the thrust capabilities of the UAG device and that depending upon the availability of a suitable nuclear source at other power supply, it could produce over 1,000 Gs of thrust if the fuel, according to UAG statement.

### **Stress Competitive Factor**

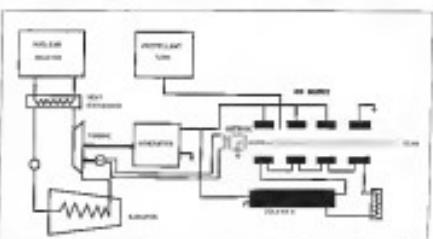
Moreover, you feel that the potential one day gives UMC a strong competitive position with other new power sources whose use requires still regimen development of future to successfully adapt microelectronic electronic devices.

Therefore, we believe that the use of the UAC ion engine could consist of a single or two engines using a battery power source into the computer. First actual application of an ion engine is expected to be in the proposed 14-hr communications satellite, whereas an ion engine program will be conducted by the National Aerospace Planning Agency (NAPA) in the future, will be used to boost the satellite from a near-earth orbit in a "stationary" 22,000 km orbit.

At the present time, there are four oscillating arm sources in operation at United Aircraft Corp Research Laboratories here each capable producing up to 30-lb thrust according to company sources. The first arm, which was built originally for investigation



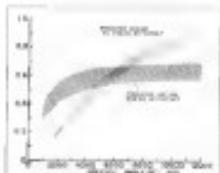
**WITH SOLIDHOUS CART** rolled back, United Aircraft Corp.'s outfalling-electron ion engine can be seen above inside plus various optics used to detect space environment.



**COMPLETE** electrical properties entries based on UAG site design or diagnosed class. Scientists in UAM Research Laboratories electrical properties facility (JPL) check those of the above's four low energy test models.



**THE DUTCH AND BELGIAN MARKETS**



PREDICTED optimum operating efficiencies of various air drives and United Aircraft ion engine as plotted on revised scale against specific impulse. Curve shows UAC drives underlie its best efficiency (10,000 sec) of lower specific impulse than current engine.

vestigation into the physics of very high temperature plasmas, is still being used primarily for the non-propulsive plasma research.

The other three units were designed and are being used solely for space applications. One, a small cylindrical device, UAC scientists are investigating different propellant feed systems. This device, for example, is being used for a study of combustible propellants such as monoxides which may prove amenable to propelling units by conducting the oxidant or a cold surface instead of requiring the huge vacuum pumps now being used in test-tube form. In an other unit, UAC scientists are investigating the use of carbon dioxide as a propellant and, later, will probably explore the propellant potential of other known solid bipropellants.

UAC scientists tend to point out that there is also another another important advantage if that it can use the existing electrical power system of the space station as a temperature source that of the continuous demand cooling point which, in the case of tungsten filaments, would be approximately 6,200°F. The UAC ion drive, with propellant recovery by Russell Mlynek, Jr., is not limited as many other ion engines are to the high cost, low ionization potential, solid metals such as cesium. To date, UAC scientists have used carbon dioxide, helium, neon, argon, hydrogen, nitrogen, mercury, krypton and even low-boiling liquids (such as a blow-up balloon) as working fluids.

**Ion Source**

Basically, the UAC oscillating-electrode source consists of a cathode, five anode rings and a ground ring joined to form a tube, a series of gaseous solenoids which step over the tube, and a last liner at one end of the tube through which the cathode and propellant feed line project.

The electrically neutral working fluid is introduced into the tube at right angles of  $10^{\circ}$  to  $10^{\circ}$  min. of arc. (In the laboratory, the ion source is enclosed in a glass vacuum system which, of course, would be unnecessary in the natural vacuum of space.) It is heated by the oscillating electrons, the neutral propellant molecules lose in-

## General Electric contributes to another space FIRST ...



FIG. 1: Nuclear Oscillation Space Probe. NERV's built-in nuclear oscillator provides the power load which extends during flight to record a vertical profile of radiation particles in the Van Allen radiation belts. Below, NERV's recovery package is shown.

# How NERV Returns Highest Space Radiation Measurements

**NASA's Nuclear Emission Recovery Vehicle, developed by General Electric Missile and Space Vehicle Department, is highest space probe ever to be recovered.**

Another major step in space exploration was achieved September 19 when NASA's first NERV—Nuclear Emission Recovery Vehicle—was successfully recovered after a 1200-nautical-mile-high flight into the Van Allen space radiation

belt. NERV brought back detailed measurements of the belt's radiation intensity.

Carrying a nuclear emission payload deep into space, NERV "plotted" a profile of the relative charged particle intensity from 5 Mev upward. Precise measurement of this radiation belt's intensity cannot be obtained before optimum shielding can be designed for manned space vehicles.

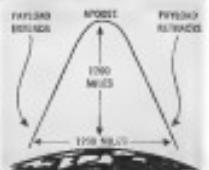
Recovery of the vehicle after flight—rather than relying only on telemetered information—permits scientists to analyze the nuclear emission directly. Thus they acquire a clearer picture of the composition of the belt, the intensity of the charged particles, their velocities,

distribution and direction of movement.

General Electric's Missile and Space Vehicle Department designed and built the Nuclear Emission Recovery Vehicle for the National Aeronautics and Space Administration's Goddard Space Flight Center.

NERV is readily adaptable to many research missions . . . where exposure of the payload to the space environment and accuracy allow flight is desired.

To learn more about NERV and other MSV programs leading toward man's entry into space, write to Section 16, General Electric Missile and Space Vehicle Department, Philadelphia 1, Pennsylvania.



MISSION PROFILE is illustrated above. After launch of the probe's three stages, a larger oscillator extends the emission package. Peaking at nearly 1200 nuclear emitted miles and well past the vehicle's orbital apogee, the vehicle is within approximately 340 nautical miles of the earth's space nerves.

**GENERAL ELECTRIC**

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A DEPARTMENT OF THE DEFENSE ELECTRONICS DIVISION

## Electrical Rockets

Current interest in electrical propulsion requires a due diligence more than anything else in the development of the new, high-thrust chemical boosters with long-pushed capabilities.

Low-thrust electrical rocket propulsion systems are most effective and preferred in space where there are power plant and fuel selection with an extremely small consumption of fuel. To be specific, while the effect of gravity is negligible, the large mass of the electrical propulsion reduces the ion drive drag with the power supply, turbine generator and propellant return so no longer the problem is in earth or in the atmosphere.

Recently developed propulsion systems can be divided into three groups: the electrostatic rocket in which the working fluid (positively charged ions and negative-charged electrons) is accelerated by voltage alone to the desired exhaust velocity; the electrodynamic rocket in which an electrically induced magnetic field is used to accelerate the charged particles and the electrokinetic rocket in which electrical energy is used to heat a propellant gas which is then expanded to work against the magnetic field of the ion current or magnetic field. The present and French NASA's work on various and continue with private industry, is currently investigating all three groups.

These three types of electrical propulsion are then further divided and classified as follows:

- Electrostatic rocket: most electrical propulsion work today is concentrated in this category. Army General Contract, Charles Wright, Electro-Optical General Electric, Goddard High Voltage Heaters, Martin, Rockwood, Thompson-Hughes Woodhead and United Aircraft are believed to be among the industry firms presently carrying out research and development in this area.

### A. Ion rocket engines

3. Positive ion current regime, probably the most popular today, in which ions are ionized when materials with low ionization potentials such as carbon and aluminum come into contact with the ionized source of metallic ions or ions and plates which have high work functions.

2. Electrodynamically driven engines in which ions are forced to diffuse against an external magnetic field. Examples of this group are the electroplasma and the magnetoplasmic drives.

B. Collected under two titles, charged particles (radiofrequency or even ionized dust) much larger or heavier than ions will still generate low thrust ion sources or devices for ionized characteristics.

- Electrodynamic rocket: At the present time there are roughly three basically different types of plasma or magnetohydrodynamic (MHD) rocket engines. In all of them, the plasma is produced either by arc discharge or resistive heating and then accelerated sterically.

A. Trapping wave oscillator: Plasma produced by electron heating is coupled between trapping magnetic fields and accelerated through a nozzle.

B. Plasma gun: Plasma is accelerated by current flowing within the plasma interacting with an externally produced magnetic field except in the case of the patch-type engine in which the magnetic field is internally generated. Besides the patch-type device, the engines in this category include the magnetohydrodynamic shock tube, pulsed gun, and gun accelerator. Both the ion and ionized magnetic field sources.

For the most part research and development on electrokinetic propulsion is being carried out in government and university laboratories such as those at University of California Radiation Laboratory of Livermore, Los Alamos Scientific Laboratories, Stevens Institute of Technology and Temple University and the National Aeronautics and Space Administration. In industry Republic, General Electric, the Lockheed and Boeing-Warren are among those believed to be working in this field.

C. MHD accelerators and plasma guns: Plasma produced by external sources is passed and accelerated in a duct in a flow created by biased electrodes and magnetic fields applied to the plasma.

- Electrokinetic rocket: As indicated by the name, this group basically falls between the low-thrust rocket and the ion and ionized. In the air jet plasma jet engine, the working fluid or gas is heated by electric arc discharges and expanded impulsively through a nozzle used to produce thrust.

Most of the work currently done on electrokinetic propulsion designs stems from the development and use of plasma jets is research such as rocket vehicle studies.

Avco, General Electric and Gannett are among the firms reported to be working presently on electrokinetic propulsion units.

electron and become positively charged.

The secondary electrons, thus knocked off the propellant molecules, also become trapped and excited.

The electrostatic potential well whose profile has been shaped by the research can be altered by shifting the voltage on the drift electrode to trap electrons, set a potential "well" for the ions, and creating them in a directed beam out of the tube. At the same time, say UAC researchers, it has been found that as a result of the ion's high thermal mobility, the ionospheric quantities of electron available in the accelerating electric current and pressure in the ion space charge field, electrons are deposited into the ion beam, causing an electrostatic space charge. The velocity of the exhaust beam can be altered to suit a specific ionization requirement they add, by altering the voltage on the electrodes or by using a different molecular weight propellant.

Not only is the exhaust beam neutral in density (that is, the number of negative electrons equals the number of positive ions in a given volume of exhaust flow), it is accelerated, but it is also equal in current (that is, the number of electrons and ions emitted is a given amount of time in the source). To verify this, UAC researchers have demonstrated negative currents through the cathode. Differentiation of the beam indicates that electrons are definitely present in the exhaust and measurement of the phase shift of the microwave beam shows an equal density of electrons and ions. UAC researchers have also put a Langmuir probe in the exhaust and code periodically measured the plasma potential and electron density.

This ability to produce an electrostatic neutral beam which is the principal advantage claimed for the UAC device over other ion drives is most important, says Dr. McNeer. At the density of electrons and ions in the exhaust, an ion current of 10 milliamperes can be obtained in a 100-volt ion drive. The current type of charge would show down similar type charges trying to leave the exhaust duct, thereby limiting current and thrust and also, by repelling each other, would spread the exhaust beam apart, creating a loss in horizontal thrust component.

If the current (number of charged particles exhausted in the same time) is unequal, a charge would build up in the vehicle. This would cause opposite charged particles in the exhaust to move back into the vehicle, and after perhaps only a microsecond, the engine would stop.

In other types of ion engines, an electron gun is located downstream to inject electrons into the ion beam, generally right above the base (anode) of the anode-cathode section. However, both

acceleration is proving a big problem, and, says Dr. McNeer, "we are still uncertain that electrons can be successfully captured and used."

As far as the performance of the UAC Research Laboratory's electrostatic-electron ion drive goes, Dr. McNeer and his group have computed a number of design parameters.

Among the more significant of these are the following:

- Specific impulse: The UAC ion rocket will operate at specific impulses ranging from 2,000 to 10,000 sec.

- Thrust: At the present, the drive has produced thrusts estimated at 91 lb. In the future, drives theoretically could be limited only by the available power source.

- Efficiency: Present engines are running at 10-25% efficiencies, but a ideal adiabatic efficiency is high as 30-40%.

- Thrust-to-weight ratio: That ratio should maintain itself at 10%.

- Beam current and power: UAC estimates its first obtained beam currents of 5 amp, and beam powers of 400 watts and eventually expect to obtain currents of 20 amp. and powers up to 10 kw.

- Voltage: Present and anticipated operating voltage ranges from 200 to 1,000 volts.

- Mass: Ion drive itself will weigh 200 lb., while the power supply and other propulsion components will weigh approximately the same as for other chemical propulsion systems.

- Power requirement: Present consumption is 1 kw. and will go to 300 kw. in later units.

- Propellant consumption: Operating at a specific impulse of 4,000 sec. and a power input of 16.5 kw., a UAC ion rocket will use .08 lb. of oxygen per hour to produce a thrust of 9.7 lb.

- Design lifetime: UAC estimates conservative 10,000 hr. or more.

Most ion propulsion systems designed as far have specific impulses between 3,000 and 25,000 sec. and, according to the Martin Co.'s William R. Clegg, by 1965, the ionized radiation associated with ion engines will have an efficiency of 75%. For certain purposes, however, particularly those of more immediate interest such as running an aircraft until a 24-hr. orbit, says Dr. McNeer, specific impulses in the 2,000-5,000 sec. range appear more attractive.

It is in this range, he adds, the ionizing acceleration can drive outmost other electric radiant such as the cosmic ion drive. For example he says, in raising a satellite from a 300-mile orbit to a 22,000-mi orbit the ion rocket would take 30 days and would have a payload-to-weight ratio of only 40%; while the ionizing electric engine could do the job in 15 days

with a payload-to-gross weight ratio of 50%.

The reason for this, he says, is that the ionizing electric ion engine does not require current (amps/sec.) or thrust, the voltage applied to the anodes can be increased, but this means a much larger and heavier power supply will be needed. While this goes up with the exhaust velocity or specific impulse, Dr. McNeer points out the electrical energy required to accelerate the charged particles to a given exhaust velocity goes up with the square of the velocity.

It is unlikely that UAC's ionizing electric ion engine will ever require more than 1,000 volts, he says, while the other rocket ion type of engine, for example, uses 10,000 volts. The current limitation and maximum current (amps/sec.) or thrust, the voltage applied to the anodes can be increased, but this means a much larger and heavier power supply will be needed. While this goes up with the exhaust velocity or specific impulse, Dr. McNeer points out the electrical energy required to accelerate the charged particles to a given exhaust velocity goes up with the square of the velocity.

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## The Hours Here Are The Most Critical

Even in the most critical time in the life of an engine, the in-between moments, to prevent damage, to prevent damage, to prevent damage, to prevent damage. More now in the test cell room makes long term possibilities for your pocketbook.

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The first two-way voice communication using the Radio 1 satellite was made by Collins Radio Company in Iowa and its systems subsidiary, Alpha Corporation of Texas. Collins also conducted signal measurements, relayed telephone messages and even a news phone. Participants in NASA's Echo project are representative of Collins' space interests. Other studies include upper-atmosphere research, and systems evaluations associated with space vehicle programs, including a linear "soft" landing. Collins also designed the first radio system and provided communication systems for Project Mercury and the X-15 rocket ship.

Challenging opportunities for engineers and scientists at all levels:



COLLINS RADIO COMPANY  
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Baton Rouge • Cedar Rapids, Iowa • Everett, California

AVIATION WEEK, October 21, 1968

It is conceivable that other electrical drives such as the reaction motor will require potentials as high as 30,000 volts. Among other things, if it is chosen, this will rule the magnetohydrodynamic drive since compatibility with low voltage fluorescent and thermoelectric units could result in considerable savings in weight.

There is, of course, still a great deal of work to be done before the magnetohydrodynamic drive becomes a feasible reality. Among the problem areas and little understood phenomena currently under study are reported by fellow investigators here at United Aircraft Corp. Research Laboratories are the following:

- Design of the potential "well" and "hill." In its effort to obtain greater thrust, UAC researchers are experimenting with different electric field shapes, seeking ways to increase ion current while maintaining a relatively constant ion energy distribution.

- Thrust loss. Related efforts are under way to understand ion motion. The placement of electric fields caused by ion guns in the cathode instead of the anode, for example, is changing the shape of the electrical field, among other things. UAC researchers hope to reduce ion loss to the cathode at least to 10%.

- Spattering. A problem common to most electrical propulsion systems, spattering is caused by the highly accelerated electrons ions that hit the cathode and knock off clusters of material. UAC researchers hope to minimize this problem again through better electron field design and through use of stronger cathode materials, different cathode designs and different propellant injection points.

- Electron loss. Some colliding electrons are lost quickly to the anode, causing heat and having short life time were. This has become the major concern to be overcome in the cathode so that the electrons can be driven off to replace those that are lost through spattering. "Well" design and reduced spatteriness, researchers hope to trap electrons more effectively.

- Efficiency. UAC scientists are working on ways to improve the overall efficiency of their ion drive. This overall figure is usually derived from two components, working fluid utilization efficiency and power conversion efficiency (beam power/prop. power).

To improve propellant utilization efficiency (that is, maximize the amount of working fluid that passes out of the device before it is ionized) and power conversion efficiency, experiments among other things are varying the shape of the potential well, strength of the magnetic field, gas pressure, gas feed points, cathode and anode design, and voltage levels.

**Large Solid Booster  
Study Areas Assigned**

Washington—Three companies selected to conduct preliminary design studies on solid propellant first stage, Thiokol Chemical Co. has been assigned the 7 million lb. first stage, and Astro-Corp. will study and design seven other vehicles in both wing clauses.

Solid propellant upper booster motors ultimately can have thrust levels five to three times the orbiter weight, and the NASA studies are being conducted to determine the ability of solids to compete with chemical regoliths in Saturn and Nova booster classes.

The three firms will conduct independent research studies. They will submit approximately \$125,000 to the contracts (AW Sept. 19, p. 20).



**Argo Flare Carrier**

Ariane Development Co.'s Argo E-5 will be used to carry four instruments to 1,000-mile altitude in ongoing experiments to begin in January at Wallops Island, Va. The Argo project includes use of widely spaced carrier vehicles that will use triangulation method to determine the exact distance between carrier vehicles. Ariane is another of the few large-scale projects and payloads.

# Dyna-Soar Flight Tests Will Involve Major Geophysical Experiments

By William S. Rose

Los Angeles—Dyna-Soar is reported to serve as a testbed for geophysical experiments during its flight-test program. Capt. F. R. Anderson of USAF Flight Test Center Edwards AFB, told the Society of Experimental Test Pilots last.

Anderson, an aeronautical research engineer in the Manned Spacecraft Environmental Office of the Flight Test Center, said geophysical experiments have been proposed to determine upper atmospheric density, pressure, temperature and composition as well as aerothermodynamics.

Major objectives of the Dyna-Soar boost-glide vehicle program will be to explore the hypersonic flight regime, evaluate maneuvering characteristics, evaluate a control system using digital pilot control, and to evaluate man's capability in a ranged part of the control system loop.

An example Anderson used to describe the magnitude of the research program is that it will be necessary to design and fabricate specialized hardware both for Dyna-Soar which can carry loads uniformly yet be sensitive to the extreme temperatures encountered during hypersonic flight.

Significant advances have been made in the knowledge of hypersonic flow, but there are more perplexing problems yet unsolved. Mathematical descriptions

of hypersonic flow is a difficult problem especially when no theory exists, Anderson said, and vehicle configuration is considered. Since current theoretical and empirical expression allow only approximate solutions, it has become necessary to rely upon wind tunnel data for evaluation of hypersonic flow field parameters. An extensive flightflow model and wind tunnel test program is scheduled for Dyna-Soar which is roughly twice that shown more common than that expended on the North American X-15. The test will take place in at least five different wind tunnels so that the intricacies of low- $\alpha$  tunnel flow can be eliminated from the data set.

## Transonic Tests

Transonic tests are of particular interest because of the comparable range in this regime to provide transonic aerodynamic characteristics at hypersonic speeds.

The design of a control system for a hypersonic vehicle is a difficult task because of the wide range of speed and altitude through which the vehicle operates. Lack of availability, changing at high Mach numbers, and the problem of low efficiency of aerodynamic control with the vehicle's long period of time will be evaluated in the transonic range.

Design of a transonic aircraft

coupling effects also interact with the high angles of attack characteristic of Dyna-Soar. Information from the X-15 flight test program will be helpful since that aircraft will investigate the region of flow dynamic processes and will derive information on the operation of transonic control systems.

The flight test program consists essentially of three basic phases:

- **A launch phase** which will have the Dyna-Soar glider carried aloft under a Boeing B-52. A small radar capsule will enable the Dyna-Soar to reach low supersonic speeds allowing the investigation of low angle-of-attack stability and control characteristics, transients and maneuvering capabilities. Data also will be generated on subsystem operations, vehicle handling qualities, braking characteristics and structural integrity. Inherent to these objectives is the observation of vehicle lifting characteristics, stability augmentation system operation, creation of positive lift, and stability and control.

- **Unmanned ground-based phase** has as its main object the functional and structural demonstration of the booster/glider combination and the evaluation of the entry system. Vibrations and noise will be evaluated in this phase. Determination of the aerodynamic characteristics of the second stage of the booster from the first, and separation of the vehicle from the second stage, also is an important part of the uncrewed program. If feasible, the vehicle will be placed into storage from the booster in order to obtain aerodynamic performance and stability and control data.

- **Manned ground-launched program** will consist of a series of flights in which the booster/burnout velocity is automatically increased in the program phases. Flights are planned to explore the stability and control and thermodynamic flight characteristics of the vehicle and provide data so that man crews safety and confidence in each flight can be optimized. During the manned program, data such as pressure, temperature, velocity and altitude will be obtained. Determination of man's capability of discretionary judgment to achieve optimum performance and reliability also will be addressed during flight test as well as in evaluation of the vehicle's aerobatics.

Program review of the X-15 rocket-launched vehicle was received by Maj. B. M. White, USAF, and J. A. Walker, NASA, members their respective staffs and high-speed wind-tunnel engineers. White described the sequence of events which occurred in his altitude flight of Aug. 12 as follows:

After launch from the B-52 at 61,000 ft, all eight thrust chambers were ignited while an 8-degree angle of attack was maintained. With the application

of thrust, the glider altitude 30 sec was maintained at about 75,000 ft, and a climb rate maintained at 60,000 ft. At this altitude, the aircraft was accelerated to Mach 1.9, after which a 1.1-g pitch-up was initiated and maximum roll attitude held, level, until an 8.5-degree angle of attack. Full airbrakes deployed, contact was established in 32 deg of pitchdown angle of attack and the aircraft's pitch angle at this point was 45.5 deg. Flight test data was recovered at 116,000 ft at an angle of attack of 10 deg.

Following a short nose-dive, data recovery equipment was released. At impact 18 deg rather than the normal angle of attack was maintained. Comparison of the landing results with those obtained during static tests at 10 deg nose-down proved one was far the margin.

In investigating the 18-deg angle of attack, rather than going to zero lift over the top, Dyna-Soar passed over the top 16.6 rad at Mach 1.61. The aircraft response was slow but positive.

An angle of attack oscillation of 8-10 deg within 10 sec was generally over the top but was fairly repeatable, except for variation of the angle of attack profile. After passing pitch altitude, White concentrated on stabilizing the entry. The aircraft started easily to a minimum 2.5 g nose-up attitude at 50,000 ft. The peak Mach number at entry was 2.1. The entry was at less than 0.1 kg per sec, approximately 45 sec and less than 0.1 g for the remainder of the entry. Sustained altitude was maintained during the entry with 20 deg out of a 35-degree angle of attack.

## Maximum Speed Flight

The maximum-speed flight was made on Aug. 4, three months after Walker's first flight on the X-15. Features as the flight plan and a working out of flight plan details by way of a ground maneuver and braking procedure with a Lockheed F-104 proved to be a good inhibitor for flight in the X-15 itself, Walker said.

Launch from the B-52 was made over Silver Lake at an altitude of 41,000 ft and at 11:10 A.M. Once again, the angle of attack was held constant at 10 deg, and the aircraft dropped to 38,000 ft before it began its climb. A relatively long profile was chosen, maintaining an 8-degree angle of attack, which resulted in a maximum lift coefficient of 0.125 at the peak altitude of the flight. At 73,000 ft, at Mach 2.2, pitchover in nose was initiated and Walker described that as the angle of attack approached zero a slow lateral oscillation developed. The oscillation tended to reduce in amplitude as the angle of attack and pitch-over velocity approached zero. At the peak altitude of 80,000 ft, at Mach 2.6, Walker initiated the assault to

3.5g and maintained this level for the remainder of the powered flight. A gradual increasing dive angle was also used during the acceleration to maximum speed. Maximum occurred at 80,000 ft, after the Machmeter had indicated above 3.5. Later, this was re-

peated down to 3.51 ft/s interval nosewings and radar data.

After burnout, drag data and stability and control data were taken following which the aircraft was turned in heading the X-15 on the dry lake at Edwards AFB.

# Heart Failure Threat to Astronauts

CORPUS CHRISTI—Cardiovascular failure poses a significant threat to the lives of astronauts according to Dr. George T. Talbot, heart specialist and endocrinologist for consultant to U.S. Air Force.

This threat is a concern to the medical community in Project Mercury and will be of even more concern to those associated with later space flight projects. Dr. Talbot told the American Medical Society annual conference here on the outcome of studies on cardiovascular disease.

Other than failure of the heart itself, the cardiovascular effect of auto-gravities, accelerations and stress on the human cardiovascular system is perhaps the greatest danger. Mercury astronauts will face the risk of saturation of an intensive research program by Air Force cardiovascular failure researcher to increase a significantly greater threat to pilots of interplanetary vehicles where the effects of gravity and other factors will be considerably prolonged.

Results of intensive examinations with the newest techniques and equipment available indicate that the Mercury astronauts are free of any significant cardiovascular disease, Dr. Talbot said. He added that the training programs designed for these men will not impair the use of any other equipment to combat cardiovascular trouble.

Another doctor, Dr. Wallace F. Ash, professor of aviation and aerospace at Ohio State University, advised, "unless," reported a potential space flight cardiovascular problem. It was accidentally discovered in senior research at Ohio State, Dr. Ash said that if a subject—an astronaut during reentry—is oriented at an angle of 12-16 deg in a supine position from 0-1.25 m in the event he would fall in his seat belt and his speech becomes unreliable.

Dr. Ash also raised the possibility which was indicated in experiments with rats that astronauts might be easily killed to sleep, in a manner reminiscent of cattle working if subjected to low frequency vibrations.

In a report submitted for the meeting but not presented, the McDonnell Corp.'s Edward C. Wertz said that human error is responsible for 25-30% of all missile system malfunctions reported each month. Copies of the report, which were available at the time of the conference, were withdrawn later by

the sponsor of The Martin Co. With better mission planning, Wertz stressed, human error or human-induced failures probably would show up at the rate of 30-50% of all reported equipment failures and 15-20% of all unexplained failures. Project Mercury astronauts in March 1961 in command of the first orbital flight of the Mercury capsule indicated that the low rate of reported "probable" failures was an "accident."

- **Poss workshop** meeting in command艂ent item
- **Fails to follow checklists**, ground ops specifications, qualifications, etc.
- **Incorrect orientation** of items

Recommendations concerning specific problems answered by this program, according to Wertz, have led to improved ratings and procedure changes which have eliminated a number of costly human-induced failures.

Edgar F. Stevens, chief of the life sciences section at Douglas Aircraft, discussed the present status of space life support systems in terms of present technology. A good example, he told Air Force, was his team's effort in Doug's work started out two years ago with three persons and now requires 32. At the present time, eight of his human factors specialists assigned as a core have, are working on the Skylab ALBM and four are working on Nike Zeon.

Ronald Konson's action separated the responsibility for human factors in transport design an area for which he sees significant growth potential associated with the development of aerospace and hypersonic aircraft.

Approximately 110 life science specialists attended the conference, first meeting held by AFSC Technical Conference on Human Factors and Biomedicine.

## Japan Plans Space, Satellite Programs

TOKYO—Japan will undertake for the first time various full-scale space programs—including a satellite—in fiscal 1963 which begins next April. Government has budgeted \$1 million for the program.

Japan's Space Development Council, headed by Kikunori Komagata, honorary professor at Tokyo University,



Photo Bounced Off Courier Satellite

This photo was sent from U.S. Army strategists responsible for Project Courier communications satellite was sent from U.S. Army Signal Corps personnel station (AFB) Oct. 15, p. 9. On the satellite, radiation and then transmitted to Ft. Monmouth, N.J. Scientists (left to right) are Walter F. Terrell, left, in charge of ground sites; and Samuel Fiedler, ground station manager. Standing are Project Manager F. W. Sibley, left, and Director G. F. Sims.

\* ENGLAND \*

## AIRCRAFT GUIDANCE AND GYRO SYSTEMS

Another aircraft Hawker Siddeley receives Ruster Trophy awarded in both the research and the theoretical awards of aircraft navigation in 20th year emerged in developing Wharton systems for the Hawker P.1127 VERTOL helicopter series aircraft.

A long period of experience with gyro techniques is essential and a large number of electronic and servo-control systems would be required for this.

Appropriate for this sector probably would be the Wharton system which is based on the gyroscopic principle and therefore the gyroscopic control system may be arranged in this manner and also that application should be used in the first instance to

Mr. E. L. CHITTY, Personnel Supervisor

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### WHAT'S NEW

#### Publications Received:

Compton-The Star of Espa Compton-William Ross Stetson-Lunde, Brown and Co., Boston, Mass. \$3.50 181 pp. A book for young people explaining the launching of nuclear missiles and the launching of nuclear missiles will explain the widespread application of these new technologies.

Prairie Air Navigation-Thiokol C-Ling, Gosselord-Werner Systems of Navigation, Inc., Minneapolis, Minn. \$1.95 191 pp. paperbound. The commercial edition of the famous Civil Aviation Bulletin No. 24. Study guide for FAA pilot ratings.

Loring-The John H. Holland-Holt, Backer and Whitney, Inc., 151 Madison Ave., New York 17, N. Y. \$1.00 256 pp. Written in association with the Inter IVA licensing procedures. Includes instructions for controlling speed, rolling, turning, banking, etc.

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## MISSILE ENGINEERING

## **ICBM Base Program Regaining Lost Time**

By Larry Bostick

Washington—Intercontinental Infra-  
bit would like its situation program ap-  
peals to be reviewed last time after  
failing getting gains which hit the  
Air Force, Army, Defense Department,  
military contractors, construction firms  
and labor unions.

Major efforts to ease construction and acquisition problems have been made over the last several years. These efforts included meetings between Defense Secretary Thomas S. Gates and construction and labor leaders in September. These meetings inspired a greater sense of urgency in contractors and labor leaders and focused attention on the need for central management on the military side.

#### **Management Feedback**

As a result, major management problems appear to have been overcome and relatively harmonious project relationships have developed as administrative procedures have been changed and management issues have been reorganized (AM, June 1, p. 200).

Scope of the home automation problem was described recently by Mr. Gru-

James P. Gandy, who was installed as successor of Eugene Middle Creek last summer with the task of solving the problem. He said:

The message of pressure equipment with a heavy contact and steel structure so that the two will work as a team. We must develop new and more effective methods to monitor these flows based on earlier flows by those sites before they can be activated at a later date.

Gathering Ideas

and types of people required on site are extended as our experience is gained as five times. What one is assumed to be relatively simple job of breaking together a few pieces of equipment and pushing the bottom to seat it if needed has turned into something of a monster. We can talk about what we do, what we might do and what we could do, but what it is and goes where often completely.

Each of our 17 houses has different unanticipated needs, and each house has

different workers. The problem is to establish an effective learning curve under these circumstances. In the following, our assignment production team aims in performing repetitively the same operation on succeeding products until

"Because of rescheduled schedules in



#### **Aero Blue Steel in Production**

One of the first production series of the Avn Flsh Steel re-to-surface weapon system is shown on slide seven in front of an Avn V-22 R, on which the missile will be mounted. Separately Flsh Steel carries nuclear warhead, is powered by a two-chambered Bristol Siddeley Rocket motor (AVN-Steel II, p. 12).

between craft and costliest wages and with even more highly complex disagreements between craft unions and management. In general, construction contractors in more than an industrial job (AW Oct. 3, p. 28).

#### Race of Progress

At present, the construction program is about one tenth complete. From a current level of 5400 jobs, some 1000 more will be added in fiscal 1962, for site construction and maintenance. Completion date is 1965. The Army program is well under way. Early efforts will be in standard "off-the-

shelf" items being used for firing and later items to have them buried in sites but raised to the surface for launching. Titan II stages will have a similar arrangement.

Titan II casings will be fired directly from their sites.

Atlas operational bases have been completed at Vandenberg AFB, Calif., and at Warren AFB, Wyo. Like the Titan II, the undifferentiated Minuteman will be fired from underground sites.

Each missile is strong; its maximum slopes or construction instabilities are made low but near when the Air Force sets up the Anderson Board, headed by Air Materiel Command Commander.

Gen. S. E. Anderson, completing his work first recently, has been succeeded by Col. James C. Johnson, who is to expand the work.

Prest concrete result of the survey made when the Corps of Engineers-Bellistic Missile Construction Office, re-created Aug. 2, with headquarters in Los Angeles, as the same building with the Bellistic Missile Center of the Air Materiel Command, which took over management of JCSBM site separation in July. CFBMCO was put under Brig. Gen. A. C. Walling, former Executive Commander of the Defense of Colonies bid, and made solely responsible for construction program, excepted administration.

Some early projects have been turned over to Walling, after the Corps of Engineers Division where they research had been administered. The shift was submitted to be completed in November.

At the same time, the Bellistic Missile Center, under Gen. Gentry, became the corps' chief liaison force for the Air Force, retaining the functions of the Air Force Civil Engineering Directorate, missile construction equipment procurement, and the Bellistic Missile Division of the Air Research and Development Command.

#### ARDC Role

From the transfer of control can take to BOMC, the site activation function, assigned to the Bellistic Missile Division of the Air Research and Development Command, which kept it until June to turn the base over to the Strategic Air Command. Now ARDC assumes the role and BMC supervises much one achievement factor as construction, test, and utilization and checkout of the system, and adherence to specifications. Its role is to prevent ARDC by giving early notice and generate changes if the contractor has retained control over the site until his return to the Air Research and Development, Air Force, and Air Materiel AFB, Calif., home, Denver, and Edwards AFB, Calif., and Offutt AFB, Neb.

In July 19, coincident with Gates, the contractors presented a list of comments and suggestions which were submitted to the Defense Department. Late in September, action on these recommendations was announced.

General complaint of the general contractors was too many bases. They suggested that since their contracts were with the Corps of Engineers the Army have sole control of construction. Establishment of CFBMCO and its construction officer is the single authority to deal with a contractor but it removed this complaint to the satisfaction of the contractors.

Another source of irritation was self, visitor and other conditions of sites selected. If sea dredged test areas were located in heavily states or rock condi-

tions, when suitable sites may call for a short distance away. One example given was a complex marsh location sites in three states, causing the contractor to deal with three sets of state laws.

Dobson replied that site selection is an optimum combination of factors such as separation distances, location and density of populated areas, access, hills for minimized support, and soil composition. In some instances, no land have been selected but all are under constant review.

#### Date Was Available

It was pointed out that no hearings and grants and weather conditions across areas available to contractors before bidding and that if conditions were different from those submitted, robust qualification evidence was set up in hands, such whatever.

With this reservation going on at the most time in the development program, change orders became a problem. There never was a result of changing requirements in the missile systems developed. With every flight at an Atlas, the contractor construction division, they received a series of change orders. This called for a revision in the number of these orders and the authority to propose alternate methods of accomplishing the task. Control and management of the program was affected as a solution to this suggestion.

Another source of contractor anger was multiple inspections. Not only did there inspection from the valuable time but this produced encroaching orders. Although there is now a central inspection procedure, there still are separate inspection teams representing the principal parties involved in site selection. But these tasks do not give evidence they favored them to the central authority.

Closely related to inspection are measurement tolerances and purity, or cleanliness, criteria. Contractors, except for those invited personally to observe plant construction, were not

invited to inspect.

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## PROBLEMATICAL RECREATIONS 38



Seven together examine a gumballine the diameter of which was sixty inches. What part of the diameter was the right-hand slice of each triangle selected? Assume that each grid has three segments.

—Edgar Dury, 1969

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## New Length Standard Has Space Application

Adoption of a new international standard of length (IAW Oct. 14, p. 59) will make it possible to check measurements to an accuracy of one 10-thousandth of an inch compared with the present, without stretching—platforms or height standards.

Elizabeth General Conference of Weights and Measures has agreed to redefine the meter at 1,450,754.71 wavelengths of measured light emitted by the isotope Uranium 235, making the most precise measurement possible.

The conference also adopted an interim standard for the second, establishing the basic unit in the length of a second as Jan. 1, 1969, at zero hours. This event will be replaced by a time zero based on oscillations of a cesium atom. A base unit based on the earth's revolution, which varies, is not adequate for the space application at the conference agreed.

Long-range implications of the new standard were discussed by James E. Pollard, president of Sheld-Camp, a subsidiary of Bird's Eye Corp., and one of the U.S. delegations. In a man shot, for example, Poll pointed out, establishment of a miliboth of an inch could raise a man.

Poll added that the Lyndon B. Johnson makes it possible for anyone who needs to split continents to have a standard in his own laboratory, like close tolerance instruments that can be operated anywhere in the world. Measurements on a thin block recently circulated among Great Britain, Germany, and the U.S. were identical to a 10-millionth, enough a billion sooner.

## Riddle Buys 7 DC-7s To Improve Service

Minneapolis-St. Paul Douglas DC-7Cs which Riddle Airlines is acquiring from General Aircraft Leasing Division of General Dynamics Corp. will be used to upgrade Riddle's DC-4 and C-46 services between Miami, New York and San Juan, Puerto Rico.

Riddle purchased the DC-7Cs for \$73,000 each as a \$9 million package purchase (IAW Oct. 10, p. 34). Spare parts ordered with each aircraft cost an additional \$1.4 million.

Riddle's contract with Douglas Aircraft which wins a \$2.7 million contract to convert the DC-7s to freighter configuration in competition with Lockheed Aircraft Service (IAW Oct. 3, p. 52), will be delivered by two aircraft in November and two in December. Two others have been delivered.

Forrest owned by Standard Air Lines Systems and Systems, the DC-7s

will soon be capable of use for freight or charter passenger operations, initially will be used to upgrade Riddle's DC-4 and C-46 service between Miami, New York and San Juan, Puerto Rico.

The airframe, which will be converted over a Cessna 441, will be converted over the DC-7s in an effort to cut total weight. American Air Transport Services continues efficient through next year. For MATS, one transatlantic flight per month is specified. Riddle has specified 99 seat revenues for the new aircraft.

Although future role for Wright 611B T-38C Commanche cockpit used on the DC-7Cs generally has evolved that of comparable size powerplants Riddle feels that it can operate the configuration combination profitably and reliably by staying economical cruise power settings. Engineering costs from Cessna Wright have ruled Riddle out of this project.

Riddle also feels that one big factor behind the carrier's shortcomings has been unrealistic speed rating of DC-7s over highly competitive route segments.

## Dassault Mirage III Crashes at Low Altitude

Dassault Mirage III crashed near Paris during a high speed, low altitude, training flight, killing the French air force test pilot. Accident happened while the pilot was executing a series of rolls at 400 ft. at an altitude of less than 100 ft. Accident marks the first Mirage III crash after more than 1,000 hr. of flight. Aircraft involved was production Model 15.

## PRODUCTION BRIEFING

General Electric Orlando, Depred unit has received Navy contract of more than \$14 million for production of tail fin control drives, motor drives of Mark 44 torpedoes via solar batteries, and development and production fabrication of ML-41 Mod. 1 projectiles for Army antiaircraft missile system.

North American Aviation's Colantonio Division is testing a rocket-powered ejection seat for VTFOL aircraft that is expected to prevent safe ejection at no forward speed from ground level to 11,000 ft.

Astro-Space Laboratories, Inc., a subsidiary of Bilkley Industries Corp., New York, has signed a \$1 million research and development contract with Hanover, Md. Astro-Space will specialize in guidance and control systems for missile and space vehicles, stable atom sources, inertial gyroscopes, closed support equipment and liquid electronic instrumentation.

**RELIABILITY**



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## NEW AVIATION PRODUCTS



### Ground System Air-Conditioning Parked Aircraft

Dryden air-conditioning system at Akron-Canton Field, Ft. Worth, Tex., provides ground cooling for a Convair 240. The tankless-type system eliminates the need for air-conditioning units and ground operation of remote cooling systems. Flexible tubes, sealed at the cooling stations extend to 20 ft. to duct the 40°F cooling air. The refrigerated ducts are produced by the Flexible Ducting Corp., Gardiner, Conn.

### Metal Seal

Metel seal is intended for sealing applications which experience cyclic two-point vibrations. The seal, called Bar-K, is said to withstand frequencies from -40° to 1,200°F and peak pressures of 40,000 psi.



### Flight Test Camera

Standard three and one-half-inch diameter flight test of the North American X-15 aircraft will be made with two Mamiya cameras. Other applications include missile and satellite testing.

The cameras measure 9 in. long, 3 in. wide and weigh 5 lb. Equipped with a polaroid attachment, the cameras provide the same changes in film at a predetermined number of frames per second to record the most important or wing surface views.

Vaughn Camera Co., Beverly Hills, Calif.

### Executive Aircraft Generator

Generator for business aircraft provides 100 amp of direct current at an rpm speed from 1,600 to 3,500 rpm. The unit will be on all new Asia Class

passenger 1600 and 6000 aircraft and will be available for retrofit.

The Model 3003 generator, rated at 100 amp, 50 Hz, is intended to handle standard electrical loads and to eliminate the necessity of carrying high voltage rigs for cabin pressurization while taxing. The weight of the generator is 90 lb.

Jack & Ehrle, Inc., Box 6917, Cleveland 3, Ohio

### Ground Power Truck

Semi-parallel ground power unit is designed to supply electrical power to transport aircraft. The power unit is under evolution at Idlewild Airport.

The Hobart Model 3165, powered



by a GMC Diesel engine, is rated at 125 kw, 6.5 gal. liter, phote, four wire, 420 rpm. The reduced control tank is 71 cu. in. high. Noise levels are reduced by the use of a centrifugal blower and two alternators.

Hobart Generator Corp., Troy, N.Y.



### Vibration Resonator

Vibration isolation resonator is intended for small equipment and instruments in jet aircraft.

The resonator is used to reduce periodic shattering protection against high-frequency excitation. A typical mount, the BL-1707, weighs 8.9 lb., supports a gross load of 100 lb. and weighs 13.3 lb. The resonator incorporates

four Molykote bearings in a shock absorber suspension which protects from vibration from -65° to +100°. Natural frequency is 45 cps.

Lead Manufacturing Co., Erie, Pa.

### High Pressure Bleed Valve

Vals to Moulton's high pressure gas or hydraulic system is intended for bleeding high pressure reservoirs in air

craft. Leakage is limited to a small leak pressure, or about 10 in. of water column. The valve has an operating pressure range of -65° to +300°, weight is 0.6 lb. The rate of the valve is from 40 to 60 cfm. at 3,000 psi pressure. Valve No. DC-1 is of chrome molybdenum construction.

Jones, Paul & Clark, Inc., Portland,



### Phillips Designs Underwing Fuel Trucks

Jet fuel trucks at Stapleton Field, Denver, Colo., are modified to fuel either Boeing 707 or Douglas DC-8 jet transports. Continental Airlines Boeing 707 (above) is fueled by four tanks situated at the center of the wings. United Air Lines Douglas DC-8s (below) receive underwing fueling from trucks spaced between engine pods on both wings. Tanks were designed by Phillips Petroleum, the fuel supplier. Capacity is 21,600 gal. each can be pumped at a 400-gpm rate.



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## FINANCIAL

### Financial Briefs

**Control Data Corp.** earnings for fiscal 1980 were \$731,656 on sales of \$3,465,780, compared with earnings of \$283,214 on sales of \$1,185,174 for the previous year.

**Atlantic Research Corp.** earnings for the six months ended June 30 were \$329,482 on sales of \$1,945,213. This compares with the previous year's first-half earnings of \$206,995 on sales of \$1,429,018.

**Siegler Corp.** earnings for the year ended June 30 were \$3,201,821 on sales of \$44,061,602, compared with earnings of \$2,283,022 on sales of \$37,074,443.

**Airtronics Corp.** reported earnings of \$6,737,361 for the first, seventh period ending Aug. 31, an increase of 11% over the comparable period of 1979. Sales increased 20% to \$108,755,344. Earnings per share of common stock increased 17 cents to \$1.47.

**Eldorado Air Lines** reported net profit for 1979 of \$206,785 compared with last year's net of \$74,397. Operating revenues for 1979 totalled \$8.1 million and operating expenses \$7.5 million compared with last year's figures of \$6.7 million and \$5.7 million, respectively.

**Dividend Income** of 23% by Cessna Aircraft Co. increases annual payout to stockholders from cents to \$1.00 per share. The dividend was declared the eighth day of 21 days before payable Sept. 27 to shareholders of record Nov. 1. This is the fourth dividend increase by Cessna in the past three years.

**Pace West Electric** has the same dividend figure and total value of more than \$100 million for the fiscal year ended Sept. 30, down from last year's \$105,705,300, with the drop attributed to lower residential and industrial businesses. Company's total plant sales reached about \$306 million, a 23% increase. Wallace said that the outlook for 1980 looks better than 1980 in volume and profits.

**Vishay Capital Investors** can show some spectacular paper profits in diversified stocks, although these might be offset by losses on others. American Research and Development, a Boston-based investment group, has 13,657 shares of High Voltage Engineering Co. up in value from \$83,727 when purchased as \$4,674,715 at the end of the first half of 1980. High Voltage holds portfolio acceleration is at issue



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Join one of industry's most progressive teams in exploring the most advanced directions of future space flight.

We are unusual opportunities for creative minds who also would like to assume increased responsibility and expand their sphere of influence.

Our fast-paced applications must have the ability to organize and direct the development of new processes and third generation supercomputers for advancement in expanding materials development programs.

**Background Preferred:** Graduate degree in metallurgy with at least four years experience including design or application work in one or more of the following areas:

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For more information, please write to Mr. A. K. Rostow, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

THE LOS ANGELES DIVISION OF  
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in the electrostatic precipitation research field.

Profits with steady profits, based on the core of the company stock market price quotation for the shares, is that rate of such a large block of the stock being a price under the figure. Such deals can be valuable as well. American Research bought 30,000 shares of Jack Corp., also a Boston company in the information retrieval field (AW Dec. 7, p. 109), for \$446,000 during the first half, and the value rose to \$773,000 at midpoint, then drop back to \$600,000 during the price action market decline.

**United Air Lines** has declared a quarterly dividend of 72 cents per common share, as well as a 7% stock dividend, payable Dec. 15 to stockholders of record Nov. 15.

**Washington**, earnings for the nine months ended Sept. 30 were \$68,686,800 on sales of \$1,457,213,800 compared with earnings of \$50,225,308 on sales of \$1,460,394,000 for the first nine months of 1978.

### New Offerings

**Technicon Instrument Corp.**, North Haven, Conn., which was organized pursuant to Delaware law on June 24, 1963, and on June 10 acquired all the outstanding stock of a Connecticut corporation of the same name from R. M. Cheek, president, and D. S. Drexler, L. Heathen, and G. F. Hewitt, officers, who acquired all the outstanding 490,000 common and 1,250 preferred shares of the new enterprise in exchange for their holdings of the predecessor company preferred stock, bonds, and common stock and sale of all electronic equipment, principally, ultracentrifugal, digital computers. Offering is 120,000 shares of common stock for public sale at \$15 per share. Proceeds will be used to repay outstanding bank loans, to purchase about \$75,000 of equipment and fixtures for its engineering laboratory, its printed circuit department and machine shop to expand the company's research and development program at an estimated cost of \$50,000 and to supplement working capital.

**Federal Pacific Electric Co.**, Newark, N.J., engaged primarily in the manufacture and marketing of selling devices for the distribution and control of electric energy, including standard low voltage equipment such as circuit breakers, safety switches, panel boards boxes and fuse boxes. Offering is 177,000 shares of common stock and \$15,000 outstanding shares of 5.5% convertible senior preferred stock with a par value of \$100 each. Of the common stock, 71,000 shares are to be offered for public sale by the company;

# RELIABILITY



Martin-Armor Missiles Master microcells of defense systems were delivered ahead of schedule and under contract price. The first of these has been in operation 24 hours a day for more than two years—with virtually 100% availability.

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SIXTH ANNUAL  
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# BUYERS' GUIDE issue



AVIATION WEEK's Annual Buyers' Guide is one source for buying information in all segments of the dynamic aerospace industry. It's on the engineer's desk... at his fingertips... readily accessible... with needed information.

The new 1963, 6th Annual Edition, now in preparation, is more complete and essential than ever before, containing expanded listings on new products and companies in new areas of the total market.

It will contain over 50,000 manufacturers' product listings in 1,800 product categories. In addition to being quick and easy to use, the BUYERS' GUIDE includes complete listings of government procurement agencies telling: Where to go; Who to see; What they buy.

BUYERS' GUIDE usage was demonstrated in a sur-

PUBLISHING DATE: Mid-December

vey conducted eight months after publication of the 1962 edition.

71% of respondents still had their copy  
60% of this group referred to it at least  
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This means your advertising is available to the purchaser or spender of the moment buying information is needed. Its constant reference value and year long life offers multiple exposure of your advertising.

Advertisers' product listings are bold faced and include a reference to the page number of their advertising. In addition to an alphabetical advertisers' index there is a "product" advertisers' index. To supply you with key industry sales leads the BUYERS' GUIDE contains Reader Service cards.

If you sell to the aerospace industry, your advertising message belongs in the BUYERS' GUIDE—as well as your company's product listings.

CLOSING DATE: November 15, 1962

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**Aviation Week**   
*and Space Technology*

# ADVANCE PROGRAMS

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to ensure its success and help our business, has resulted  
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giving details of education, experience, list of publications and salary desired.

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offering price and underwriting terms to be supplied by underwriter. The additional 122,000 common shares represent part of the consideration being paid by the company for all the outstanding common stock of Power Shoring Ltd. (a Canadian company) from its sole existing shareholder. Proceeds of the sale of the 133,000 common shares will be applied toward supplying the cash consideration for the purchase of the Power stock, the balance to retire short term bank loans and for working capital.

**Gordon Industries, Inc.**, Mitchell, N.J., engaged in the research, development and manufacture of electronic, electro-mechanical and electro-optical components, equipment and systems which are sold to the military and to commercial manufacturers. Offering is 108,000 shares of common stock for public sale, offering price and underwriting terms to be supplied by underwriter. Proceeds will be used to expand the company's product lines and an large part thereof will be invested in short term government securities; thereafter, funds will be available as additional working capital for the carrying of inventories and accounts receivable. In addition, the company intends to apply a substantial portion of such proceeds to the acquisition of additional complementary businesses. The company recently acquired a 47% interest in Systems Research Company in New Milford, N.Y., and has contracted to purchase the remaining 53% interest, the total purchase price being \$150,000 plus premiums over the next three years in company stock.

**Lithuanian Corporation of America**, New York, N.Y., principal business, the production and sale of lithographic and lithuanian compounds, principally sales and research efforts, the development of new products and new uses for such products. Recently the company has expanded its business into various phases of industry and commerce. Offering is \$2,700,000 of convertible subordinated debentures, due 1978, for public sale, interest rate, offering price and underwriting terms to be supplied by underwriter. First, however, the new debentures will be offered in exchange for \$375,000 of outstanding 5% convertible debentures maturing in 1964. Proceeds stemming after disposition of the debentures due 1964 will be used as follows: \$75,000 for construction of facilities to be used in production of lithophanes and other photographic compounds, \$125,000 for purchase of mining equipment to increase the company's North Carolina mining operations, the balance for liquidation of bank debt and replacement of working capital.

# RELIABILITY



Navy test Air Force Bulgejet (AF GAM-83 has been called by the Navy "the world's most reliable guided missile.") It is an test-free it can be handled in an ordinary room of illumination.

**MARTIN**



and, took over sufficient fuel to take off and land back at the original site and that No. 1 had tank trouble and had to land back at his office. It is also observed that the captain did not move the fuel selector during the emergency at intervals possible in the capture but maintains can adjust himself to be in a fixed position at all times. Therefore, that the captain had fuel selector movements are not to the same but fuel tank one remark made was that they were performed by the forward deacons at least.

The flight crew suggested suspension of maintenance. But the fact that there was no communication between the two crews caused the engine information to be lost of fuel samples and investigation of an part fuel handling and dispensing. The crew had taken some effort to a total of 950 gal. See the later section, fuel tanks were not full. Total 215 gal of fuel measured by crew after they landed as indicated in the report when checked by the pressure gauge.

While it is not understandable for the captain to have considered the possibility of suspension but as a result for the loss of fuel he should be held responsible for loss. There appears to be a lack of communication at the time of the selection of fuel mixture. Therefore, if fuel pressure and fuel flow should have altered the captain in the switch probably prevent him in case of the rupture of the engine or fuel tank then the fuel system would not have been able to handle the fuel and the fuel mixture would have been the fact that the low cylinder head was positive eliminated the possibility of the presence of jet fuel. Switching fuel after

tens to number fuel should normally be one of the first acts of a pilot after a engine shutdown or fuel pressure and fuel tank.

In addition, Capt. Red had due to more rounds to analyze the problem before engine.

#### Possible Cause

The Board determines that the probable cause of the accident was an aircraft fuel system malfunction resulting in a pressure drop in the system.

In the Civil Aeronautics Board:

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J. S. BROWNS
MEMBERS

The Civil Aeronautics Board was very kind of the accident analysis when a review of an investigation is conducted. An examination of the transcript of the Federal Aviation Act Title VII of Part 105.

United States Ocean Airlines, Inc holds a license, FAR certificate of public transportation and authority to operate a commercial implementation of Captain's Air Charter, No. 105-A and No. 105-C. Captain Operating Certificate No. NY-1 underlining requires at least one passenger and cargo operation. The masters pass-

enger operating and maintenance has a license in Captain. Merchant Captain's Ocean Charter.

Capt. Fred age 47 was employed by U. S. Airways, Inc. on Jan. 22, 1968, as a first officer. He had been flying for approximately three years. U. S. Airways has a used winter or transport type equipment. He held a commercial airplane rating with instrument rating. His last flight inspection was conducted Aug. 7, 1968. He was operating in his cockpit on Feb. 8, 1969, and in captain on Aug. 10, 1969. He had a total of 82,465 flying hours, 70% of which occur in C-46 type aircraft. He had fewer than 100 hours in which he had not done all of which were in C-46 type aircraft. He had completed the required annual recurrent training and proficiency checks.

Captain Gordon Cole, age 47, was employed by U. S. Airways, Inc., on July 10, 1969. He held a private certificate with commercial ratings and instrument had rating. He had a total of 10,000 flying hours, 70% of which were in C-46 type aircraft. He had fewer than 100 hours in which he had not done all of which were in C-46 type aircraft. He had completed the required annual recurrent training and proficiency checks.

Dragon C-141, N. 4008A, serial number 60-0608, was purchased by D. B. Morris, Inc., Atlanta, Georgia, on Dec. 16, 1968. Serial number 16, 1968, was assigned to the aircraft. On Jan. 10, 1969, it was on a cargo configuration. It had a total flying time of 92,356 hr. 10,545 hr. since its last major overhaul. Nos. 1 and 4 engines were

operating and maintenance has a license in Captain. Merchant Captain's Ocean Charter.

#### Turbulence May Have Caused B-26 to Crash

Washington—Preliminary that severe turbulence played a major role in the crash of a Continental Cessna 210B on July 1, 1968, near Marion, Ohio, was stated in a recent Civil Aeronautics Board accident report.

Board investigators were unable to determine the possible cause of the accident because of the much complex definition of the word, but the report indicated the overall approach was out of control while flying through an active line of developing thunderstorms.

Planes by Commandant pilot Peter R. Dawson and Robert Morris, the co-pilot, ran out of fuel from Chicago to Elkhorn, Mo., with eight compass passengers, when it was seen to enter a near vertical dive from an altitude of 4,000 ft. and crash at a point about three miles from Marion and 15 mi.

from the flight's planned course. Speed of impact was "extremely high," CAA said, with heavier portions of the aircraft found embedded nearly eight feet in hard clay. Crews and passengers were all killed.

The Board found no evidence of structural damage or powerplant failure, but said, "However, it is possible the aircraft may have sustained structural damage which could have caused the dive, as a result of flying through severe turbulence, a few minutes before."

While the aircraft's course deviation may have been a pilot's attempt to avoid the worst of the weather as indicated by airborne radar, CAA investigators said they were unable to explain how or why the aircraft descended from its assigned 9,000 ft. altitude to only 4,000 ft. over Marion. In addition, they singled out the two pilots' competence as being of high quality, with records showing that Dawson had total flying time of 10,577 hr., with 305 on the B-26, and Morris had 3,785 hr. with 1,719 on the bi-engine aircraft.

Because of the unusual flight, weather observers were unavailable but not expected by the flight, CAA said.



PanAm Skyscraper

The \$100 million, 55-story skyscraper now under construction in midtown Manhattan, featuring General Control's Traveler, will be the name of Pan American World Airways. The office will house 615,000 sq ft of space in the Petcoke building. The new quarters will house executive offices, traffic and sales, reservations engineering, communications, industrial relations, and account of supply. Deregulation is expected in 1965.

# POLARIS ON PATROL

**LOCKHEED**  
MISSILES & SPACE DIVISION, SUNNYVALE, CALIFORNIA

## WHO'S WHERE

(Continued from page 24)

### Honors and Elections

Robert Nelson, manager of Pabst Special Publications at General Electric's Lamp & Electric Department, has been elected national chairman of Aerospace Industries Association's Aerospace Committees. He succeeds Robert C. Johnson, Jr., manager of the Lamp & Electric Division of the Western Hemisphere Technical Conference of the International Air Transport Assn.

John E. Rudder, recently manager of United Technologies Corp.'s New York aircraft division, has been elected chairman of the Aerospace Committee. In addition, incoming Executive Vice President John E. Ruddy Jr., who was elected chairman of the board after his fellow officers Ernest E. Folger of General Precision Equipment Co., first vice president, John J. Ament of General Motors Corp., and second vice president, George D. Blodgett, head of Control Division of General Dynamics Corp., appointed Joseph F. Delaney, of Bell Telephone Laboratories Inc., treasurer; Mrs. Thomas J. O'Neill of Standard Research Institute, and Timothy J. Walsh, of Sperry Gyroscope Co., director.

### Changes

Capt. James B. Darden (USN) has been named manager of planning and development at North American's Washington, Va., Richard Zeidin, London, has been promoted to manager (Westinghouse, N.Y.), and to senior manager, Inc. (18 Septembre, Calif.).

Morris J. Beck has been appointed manager of Bell Telephone Laboratories Inc., Worcester; Mrs. Thomas J. O'Neill of Standard Research Institute, and Timothy J. Walsh, of Sperry Gyroscope Co., elected

to re-enter the Board of directors of an unnamed MHD Research Inc., Newport Beach, Calif.

In Boston, L. Brinkley Jr., manager of the push button telephone division and its former Boston Division, Lincoln Telephone and Telegraph Co., Pasadena, Calif.

Robert G. Marshall, director-engineers, con-

trols, Melpar Inc., Falls Church, Va., a subsidiary of Westinghouse Air Brake Co.

Ed Shuman & Harry (H.A.) Hiltz, managers of Southern Circuit Co. of Atlanta, Ga., office.

Charles R. Stiles, manager of United Technologies' Los Angeles liaison office on Los Angeles' Calif., has been appointed manager of Lockheed's Los Angeles office of the Pacific Division of the Lockheed Aircraft Corporation, Division, Falls Creek, Calif. (Miss). Karen W. Schildknecht, representative, C. J. Boerner, director of administration and finance, D. W. Gray, manager of research.

Ed A. Long, assistant director of the John DeLoach Laboratories Inc. (Pittsburgh) and Applied Source, General Motors Co., director of General Dynamics Corp.; Neil Davis, Calif.

Ed Galdon G. Dowdy, director of long range nuclear planning, The Boeing Corp., Detroit, Mich.

John E. Rudder, recently manager of United Technologies Corp., New York, has been elected chairman of the Aerospace Committees.

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The Columbus Division of North American Aviation is a center of total systems capability. It is the developer of the most advanced aircraft—such as the A3F Vigilante and the T-38 Trainer—but also of missiles, media/radar intelligence systems, and navigation systems, and other diverse products. The Columbus Division is also the center of extensive advanced R&D projects. Here, there are substantial opportunities to contribute to advanced technology—and to forward your own career.

Currently, the Columbus Division has openings for SYSTEMS ENGINEERS. These engineers will assume responsibility for airplane electronic systems. To qualify for these positions, you should have a background in one or more of the following fields: RIM, radar, packaging, reliability, antennas, data processing, communications or associated systems and components, and design of logic digital computers. They should have a BS/BSR, or the equivalent, plus three years experience.

If you meet these qualifications and seek an opportunity to advance your career, please contact us right now. Send a brief resume in confidence to:

Mr. J. A. Hirschbeck  
Engineering Personnel, Box A.W.-327  
North American Aviation, Inc.  
Columbus, Ohio

THE COLUMBUS  
DIVISION OF  
NORTH AMERICAN AVIATION, INC.



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The advertisement may be used for advertising reselling or selling items or services offered. Contact cities or regions for information. Items to be sold must be limited to one where the item is being sold.

RENTAL EQUIPMENT - FOR SALE

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ITEMS WHICH ARE FOR LEASE

ITEMS WHICH ARE FOR RENT

ITEMS WHICH ARE FOR LEASING

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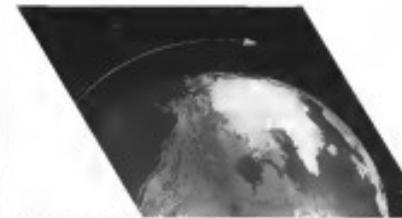
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Social Security No. \_\_\_\_\_

Present Address: \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Other \_\_\_\_\_

Telephone No. \_\_\_\_\_

II. \_\_\_\_\_ Wh. \_\_\_\_\_ Age \_\_\_\_\_ U.S. Citizen \_\_\_\_\_

Male \_\_\_\_\_ Female \_\_\_\_\_ Marital Status \_\_\_\_\_

No. of Children \_\_\_\_\_ Other Dependents \_\_\_\_\_

I. S. Veteran \_\_\_\_\_ Entry Date \_\_\_\_\_

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Type of Discharge \_\_\_\_\_

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Employer \_\_\_\_\_

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1) Have you any physical defects? \_\_\_\_\_

2) Have you ever been convicted except traffic and juvenile? \_\_\_\_\_

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College and Location	High School	Other and Major
1 _____	_____	_____
2 _____	_____	_____

## EMPLOYMENT HISTORY

From State and Salary      Date From      When Employed  
1 \_\_\_\_\_      \_\_\_\_\_/\_\_\_\_/\_\_\_\_      \_\_\_\_\_

To \_\_\_\_\_      \_\_\_\_\_/\_\_\_\_/\_\_\_\_      \_\_\_\_\_

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To \_\_\_\_\_      \_\_\_\_\_/\_\_\_\_/\_\_\_\_      \_\_\_\_\_

**REFERENCES:** Give full names, occupations and addresses  
of professional (previous supervisor preferred)

1 \_\_\_\_\_  
2 \_\_\_\_\_

Character (other than relatives or former employer):

1 \_\_\_\_\_  
2 \_\_\_\_\_

**LIST TYPE OF WORK PREFERRED UPON  
EMPLOYMENT:**

\_\_\_\_\_

\_\_\_\_\_

Have you ever been cleared for classified military information? \_\_\_\_\_ If yes, give date, level and company

Will we contact your former and present employer prior to completion of employment negotiations? Yes \_\_\_\_\_ No \_\_\_\_\_  
If "yes", I authorize, without liability, the release of all completed and pre-existing information

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• **CONTROL SYSTEMS:** BS in Physics, Aerodynamics, or Mathematics. 10-15 years experience in Aerodynamics, Applied Math. Study in Stability, Analysis, Maneuvering, Propulsion, Transient, State-estimation Theory, Computer Design.

• **GUIDANCE AND CONTROL:** BS in Physics, Math or Applied mechanics with 10-15 years experience in Applied Math, Aerodynamics, Computer Techniques. Study in Stability Analysis, Servo-mechanisms, Guidance Navigation, Systems Analysis, Computer Systems.

• **COMMUNICATIONS:** BS in Electrical Engineering or Physics with 10-12 years experience in Electrical Engineering for Communications. Study in Frequency Modulation, Radio Transmission and Reception, Radio Preparation, Cryptocommunications and Counter-countermeasures, Security Coding.

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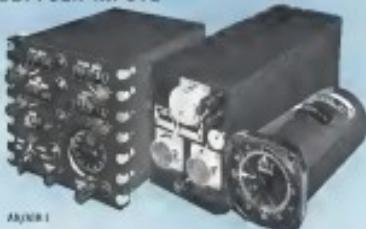




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**OFFER HIGHEST ACCURACY**, the article in the Sept. 5 issue of *Aerospace Week*, "New System Nerve Gas Detector," (p. 31) indicates that need for a new phosgene gas weapon system developed. Until now no reliable and efficient system have been based on the "solid" or "wired" detector detection principle. For a reliable and reliable detector, however, the concept needs of Numberical readout. When one considers the relative effect and overall toxicity the results are founded on the more dangerous weapons because a biological method to detect the end point of the detector would be much more difficult.

We feel that the man in any area where such expandable work occurs to be clear and where considerable challenge is presented to physicists and other scientists working in the fields of solid state and electronics to develop a reliable detector for the detection of nerve gases. The development of a reliable detector for nerve gas detection will be first step to prevent re-enactment of this tragic event to be done safely. In this regard we would like to call your attention to a source of pulse detectors which has been designed in America which is manufactured under the financial support of the Defense Department and can be performed as a receiver and safe device.

This pulse source is known as the Solid State Type Pulse Receiver (STR). It is based on the same basic principle as the solid state ionization research sources which have been designed, manufactured and tested by the Defense Department and contractors today in various parts of the world. The STR's will produce pulses of 10<sup>-9</sup> seconds/cm<sup>2</sup> and 10<sup>-8</sup> g/cm<sup>2</sup> seconds, each total energy of 5.0 microjoules, pulse widths of 1.0-1.5 milliseconds at the half-maximum point and peak powers of apparently 2.00 megawatts.

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## LETTERS

## The Poor Passenger

Jim said your column "Try the Poor Passenger" (AVW Oct. 3), while interesting, is a "Wise Counsel" trap set up at my cost when I was flying by reservation.

To add: Annex A to what you report you describe an average "TBT" departure flight in well-known foreign schedules. As the saying goes, "There is room for improvement, etc., etc." by great.

Aircraft Owners and Pilots Assn.  
Washington, D.C.

I am most interested and greatly annoyed with your editorial in the Oct. 3 issue of *Aerospace Week* concerning the Poor Passenger. I cannot help but agree that after completing a flight one wonders who the an-  
tis are now in the passenger or a member of the National Association of Architects and Old Van Guards.

After visiting a friend in the Los Angeles International Air Terminal last weekend, we stood in the baggage room for 15 min waiting to get our checked bags checked. The airline people were friendly and left. I suppose I could take it rather well but part as much with the other user.

As reference to the design of an terminal, however, I am not a little horrified at some of the proposed designs. Since I have seen the plans for more than one place the idea of a terminal with a large number of small terminals for design purposes than for efficiency. I know that this one thing I am interested in when I go to a place is to find a place to park as close as possible to the service I am interested in and then get there as fast as possible, without having to walk all the way to the terminal. The situation in the airport design and parking problems seems to me less efficient than I have read. Why not design a normal terminal building with robust spaces for landing and provide a small garage for parking? Equally important, the parking should be related to the size of the terminal.

The bus lines and subways would be housed, on site, their major problem with "chargeable" type tickets the standard point to point trip. Who can't afford? Of course, including the public on these busses would be recommended since their use would be encouraged.

Enclosed William R. Gossman, MSN,  
North Atlantic R. Veterans Center  
Pt. Mugu, Calif.

Your editorial in the Oct. 3 issue of *Aerospace Week* is an important reminder for us to be held.

As the editor of the leading aviation publication in the world, we are going to make and provide accurate information to the public in helping others to solve the problem.

O. L. Brown  
Manager, Electronic Systems Division  
Bathgate Co.  
Bethpage, N.Y.

Acting Week welcomes the opinions of its readers on the various issues of the magazine. Letters to the editor should be addressed to the Editor, *Aerospace Week*, 3000 Bldg. 4800 S. New York St., N.Y. 10016. Please keep them 200 words or less. We will give preference to letters from our members. Letters from other sources may be withheld at our discretion.

## Synchronous Satellite

A response is made to come article entitled, "Synchronous Satellite," (See page 10 in the Sept. 11, 1971 issue of *Aerospace Week*).

The statement is made both in the text and under one of the illustrations that a synchronous satellite rotates the equator every 6 hours. This is not true. It rotates around the earth over once, 24 hr. Therefore, a satellite of this type, whose orbit is inclined to the equator, rotates the equator every 12 hr and even, if it is

Maxwell Station  
Enchanted Oaks Research  
Division  
Wright Air Development Division  
WADC  
Wright-Patterson AFB, Ohio

(Reader Service Account) The author's numbers require the reader move over, if in question of its orbital inclination.—Ed.)

## Pulse Radiation

There are very much for the recent article on nuclear pulse inhibitors in the *Aerospace Week* issue of Aug. 25 (p. 18) by Andrew W. Wilson. The author's point is well taken, namely, that the nuclear pulse inhibitor is not the best choice for certain applications as pulse radiation, not sponsored by the Air Force, at the Air Force Special Weapons Center in Albuquerque, has helped to pass out the word that the field of understanding of instrument noise effects.

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In addition to breadth meter calibrator characteristics, the homogeneous nature of the advantage of expandable sensitivity and reliability.

Extensive safety investigations, monitored by AF under the ADC-supported program "Kestrel Requirements of Weather Balloons," have conclusively demonstrated that point. During these tests, the radiosonde was subjected to a pressure of less than one millibar and a rate of rise of 10 m/sec. The radiosonde continued to fly STP's until it finally exploded in the stratosphere at about 10 km, causing damage or destruction to most heterogeneous thermal resistor assemblies.

We are confident of the safety of the STP's in the present form of the product and believe that the present safety of these solar cells exceeds the requirements of the space station concept which, in its operation is pulse source. We will release documents regarding the characteristics of the STP's in reply, cost, or its applicability to transient or long-term testing.

M. M. Hartman  
Atmospheric Instrumentation Division  
North American Aviation, Inc.  
Chicago Park, Calif.

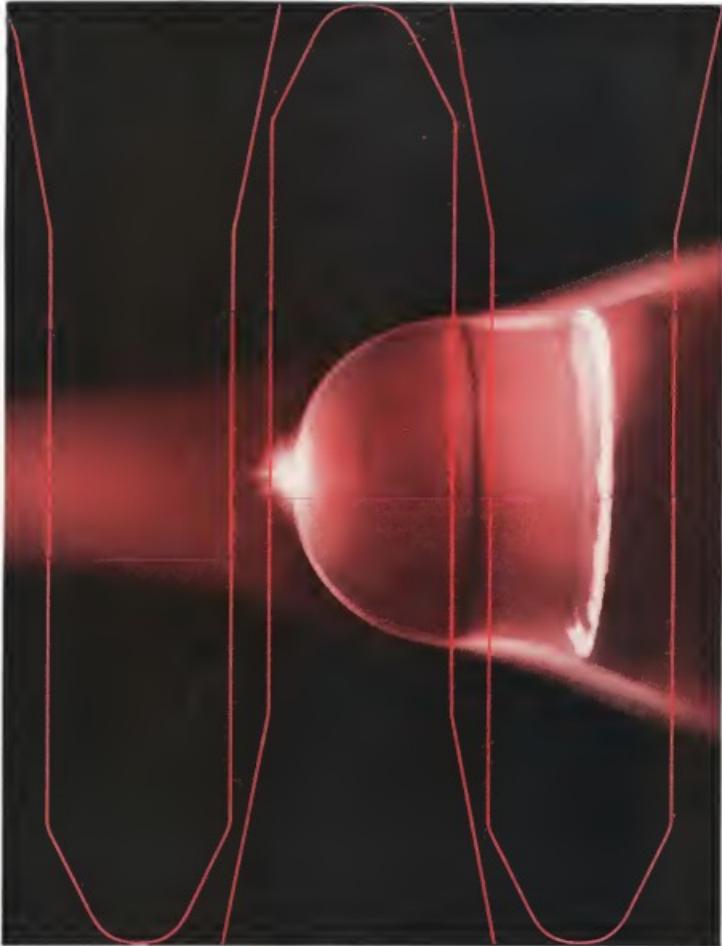
## Nerve Gases

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Ronald A. Vancorah  
Los Angeles, Calif.



**Blasting new materials to make missile nose cones.** The first ICBM nose cone ever to be recovered after flight was protected by a new, high-temperature material. Its name: Avcoite. Its construction: specially reinforced ceramic. Avcoite was the first of a family of new heat-shielding materials. They were developed for re-entering nose cones and satellites by Avco's Research and Advanced Development Division. Newest addition to this materials family is Avcoat, a plastic heat-shield here ablating smoothly in a hydrogen-oxygen jet simulating satellite re-entry temperatures.

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